FFY 2008 Specialty Crop Block Grant Program

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Final Report

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Division of Marketing

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1.
Project Title: Sustainable Fresh Market Tomato Nitrogen Fertilization
Lead: M. Reiter
Amount: $21,750

I. Project Summary

Nitrogen (N) fertilizer can be applied efficiently and effectively, but nutrient recommendations must be made for specific soil types and land use areas in each region. Current fertilizer recommendations for tomato production in Virginia are outdated as the production system has drastically changed in recent years. Intensive tomato production systems using plastic mulch, drip irrigation, cover crops, and hybrid varieties have resulted in substantial increases in tomato yields per acre. Therefore, current fertilizer needs are higher than in traditional bare-ground and processing tomato systems and fertilizer recommendations need to be improved. Since the official Virginia recommendation is out-dated, fertilizer recommendations commonly used for commercial tomato production in Virginia were developed and tested in California and Florida. These states use different tomato varieties, have different soil types, and have different climates. New fertilizer application practices for Virginia need to be developed to replace those researched and developed under different growing conditions to ensure fertilizer efficiency and reduce nutrient losses to the environment, while maintaining productivity. Identifying nitrogen fertilization practices will also help farmers remain profitable, as fertilizer prices over the last ten years have increased over 400%; while average crop prices have increased only 85%.

Commercial tomato production has the potential to negatively impact the Chesapeake Bay ecosystem if not managed carefully. Runoff and leachate from tomato fields may contain nutrients that cause excessive algae production in the estuarine environment. Eutrophication, or fertilization of a waterway, is commonly associated with death of native aquatic vegetation, death of fish and shellfish due to low dissolved oxygen concentrations, and makes water unfit for recreational sports such as boating and swimming. Reduction of Chesapeake Bay nutrient inputs is imperative for restoration of native species and native population levels. The two major nutrients of concern regarding accelerated eutrophication and algae blooms are nitrogen and phosphorus. Nitrogen quickly moves through sandy soils; which is the predominant soil in Virginia tomato production systems across the state. Therefore, proper nitrogen fertilizer management is not only important agronomically, but also environmentally.

II. Project Approach

Materials and Methods:

This study was established in Spring, 2009, on a Bojac sandy loam (coarse-loamy, mixed, semiactive, thermic Typic Hapludults) at the Virginia Tech Eastern Shore Agricultural Research and Extension Center in Painter, Virginia (37.59°N 75.77°W). Bojac sandy loam has 59% sand, 23% silt, and 11% clay in the Ap horizon. **The soil was** conventionally tilled, and 20 cm raised beds were constructed on 1.8 m centers and covered with polyethylene mulch. Drip irrigation was placed under the polyethylene on one side of the bed (Fig. 1). Tomato seedlings (approximately 20 cm tall; variety: BHN 602) were transplanted on May 20, 2009 and May 21, 2010.

Nine N fertilizer treatments were implemented in a 4 N rate × 2 N application method factorial arrangement to determine N management's effect on yield, other plant growth, and soil parameters. A 0-N treatment was also included. For all treatments, N rates totaling 112, 224, 336, and 448 kg N ha^{-1} were applied and split with 50% of total N applied under plastic mulch (source: 34% ammonium nitrate) and 50% applied through biweekly fertigation (source: 32% urea ammonium nitrate solution) over the growing season. The "incorporated method" (Fig. 1) consisted of 50% total N (100% total pre-plant N) being incorporated into the plant beds immediately prior to polyethylene mulch application. The second application method, the "banded method" (Fig. 2), consisted of 16.7% total N (1/3 total pre-plant N) being incorporated into the plant beds and 33.3% total N (2/3 total pre-plant N) being applied as a band on the top of the beds immediately before polyethylene mulch was laid. The band was located halfway between the drip tape and edge of the plant bed. All other nutrient applications and production practices were made according to Virginia Cooperative Extension recommendations for tomatoes.

Petiole sap nitrate tests and infrared camera tests were performed when fruit was 5 cm in diameter. Petioles were collected from 6 plants per plot. The sap of all six petioles was combined and nitrate concentrations were found using a Cardy meter (Spectrum Technologies, Plainfield, Illinois 60585). Petiole nitrate samples were taken to measure plant nitrogen status and were related back to marketable yield. An infrared camera (Greenseeker, NTech Industries, Ukiah, CA 95482) was used to determine Normalized Difference Vegetative Index (NDVI) readings. NDVI readings from the Greenseeker can depict in-season N status of plants and correlate to plant biomass and plant N concentration. The infrared camera was used to establish a greenness index and was related back to marketable tomato yield. Water quality measurements were taken from a 46 cm depth using suction cup lysimeters to measure possible nitrogen leaching through the vadose zone. Collection of water samples was performed on a weekly basis throughout the growing season. Collection terminated at last harvest. Tomato roots grow to a depth of approximately 40 cm, so fertilizer below this root zone is in danger of entering groundwater, drinking wells, and/or flowing via lateral flow into nearby waterways. Water samples were analyzed for ammonium and nitrate colorimetrically using a continuous flow auto analyzer. Mature green fruit were harvested and total marketable yields were graded and weighed according to USDA standards. Yields were regressed against N rates.

RESULTS:

Yield: In 2009, there was a quadratic relationship between yield and N rate for the incorporated method ($y = -0.6802x^2 + 249.95x + 47830$, $R^2 = 0.93$) and the banded method ($y = -0.4153x^2 + 200.81x + 48524$, $R^2 = 0.88$) (Fig. 3). Overall, a N rate of 184 kg ha^{-1} produced highest yields with the incorporation method with an agronomic efficiency of 301 kg fruit kg N^{-1}. A N rate of 242 kg ha^{-1} produced highest yields with the banded method with an agronomic efficiency of 384 kg fruit kg N^{-1}. The incorporated method produced similar peak yield to the banded method but shows larger yield loss at higher N rates. The decrease in yield may be due to higher salt concentrations in the soil at higher N rates, causing plant injury.

In 2010, there was a quadratic relationship between yield and N rate for the incorporated method ($y = -0.6702x^2 + 91.962x + 17830$, $R^2 = 0.79$) and the banded method ($y = -0.2467x^2 + 87.583x + 18029$, $R^2 = 0.46$) (Fig. 4). Overall, a N rate of 69 kg ha^{-1} produced highest yields with the

incorporation method with an agronomic efficiency of 304 kg fruit kg N^{-1}. A N rate of 178 kg ha^{-1} produced highest yields with the banded method with an agronomic efficiency of 145 kg fruit kg N^{-1}. The three highest N rates using the incorporated method resulted in severe crop injury to plants, possibly due to salt injury. Plant stand counts and soil salt concentrations (data not shown) validated plant injury as they related to high salt concentrations. Overall lower yields compared to 2009 may be related to the 2010 growing season being unseasonably hot accompanied by a severe drought. Soil temperatures under the black polyethylene mulch reached 50°C, which in turn may have inhibited root growth and plant development.

Petiole Sap Nitrate Tests: Petiole nitrate (NO_3-N) readings were plotted against average marketable yield. In 2009, there was a quadratic relationship between yield and petiole N concentration for the incorporated method ($y = -0.0989x^2 + 152.99x + 15812$, $R^2 = 1$) and the banded method ($y = -0.0756x^2 + 124.02x + 22347$, $R^2 = 0.9291$) (Fig. 5). Overall, a petiole N concentration of 773 mg kg^{-1} produced highest yields with the incorporation method. A petiole N concentration of 820 mg kg^{-1} produced highest yields with the banded method. Florida recommendations suggest a petiole sap nitrate (NO_3-N) concentration of 400-600 mg kg^{-1} for a plant with fruits at 5 cm diameter.

In 2010, there was a quadratic relationship between yield and petiole N concentration for the incorporated method ($y = -0.0321x^2 + 25.498x + 14377$, $R^2 = 0.6179$) and the banded method ($y = -0.0613x^2 + 91.096x - 7388.1$, $R^2 = 0.6974$). Overall, a petiole N concentration of 397 mg kg^{-1} produced highest yields with the incorporation method, but yields were overall lower than expected due to an abnormally high, record hot summer. Significant yield loss was observed with higher N rates using the incorporated method in 2010, causing the petiole nitrate peak to be lower than it was in 2009. However, a petiole N concentration of 743 mg kg^{-1} produced highest yields with the banded method, although yields were still lower than ideal. A third growing season would be beneficial in determining more petiole sap nitrate readings under different climactic conditions. Overall, recommendations for petiole sap nitrate (NO_3-N) should be updated for the Mid-Atlantic region and increased to a range of 700 to 900 mg kg^{-1} for maximum productivity.

NDVI Readings: Normalized Difference Vegetative Index readings were plotted against average marketable yield. In 2009, there was a quadratic relationship between yield and NDVI readings for the incorporated method ($y = 1E+07x^2 - 2E+07x + 1E+07$, $R^2 = 0.8883$) and the banded method ($y = -1E+08x^2 + 3E+08x - 1E+08$, $R^2 = 0.9746$) (Fig. 7). There was a quadratic relationship between yield and NDVI readings for the incorporated method ($y = -8E+06x^2 + 1E+07x - 5E+06$, $R^2 = 0.6885$) and a linear relationship for the banded method ($y = 116066x - 76295$, $R^2 = 0.7561$) in 2010 (Fig. 8). These relationships vary considerably between application methods and years. In 2009, the incorporated method had a positive correlation, while in 2010, it had a negative correlation. In 2009, the banded method had a negative correlation, while in 2010, it had a positive correlation. We suspect that fruit color present at the time of testing affected NDVI values. Further testing should be done to determine if NDVI can be used to predict yield in fresh market tomatoes using various procedures (for example: side of plant versus top of plant). Currently, data shows that NDVI may not be a good means to predict marketable yield of fresh market tomatoes.

Lysimeters: In 2009, there was a linear relationship between inorganic N (NH_3 + NO_3-N) found in water samples collected from suction cup lysimeters and total N applied over the growing season for the incorporated method ($y = 0.0142x + 11.609$, $R^2 = 0.41$) and the banded method ($y = -0.0013x + 13.775$, $R^2 = 0.01$) (Fig. 9). The incorporated method shows an increase in inorganic N in leachate below the root zone as total applied N increases. However, using the banded method, the fertilizer band did not dissolve as quickly as incorporated fertilizer and was not leached as readily. Therefore, the banded fertilizer treatments did not have any increases in soil water inorganic N as fertilizer rates increased. We speculate that tomatoes with banded N treatments were able to utilize the N fertilizer as it was dissolved by irrigation water over the entire growing season.

In 2010, there was a linear relationship between inorganic N (NH_3 + NO_3-N) found in water samples collected from suction cup lysimeters and total N applied over the growing season for the incorporated method ($y = 0.1213x - 0.8515$, $R^2 = 0.97$) and the banded method ($y = 0.0346x + 1.4239$, $R^2 = 0.71$) (Fig. 10). Both application methods showed an increase in inorganic N in leachate below the root zone as total applied N increased. The incorporated method indicated higher inorganic N in leachate as total applied N rates increased compared to the banded method. Using an incorporated method for fertilizer may create a higher concentration of dissolved fertilizer in the soil that is susceptible to leaching. Reduced yields in 2010 lessened plant uptake of N and resulted in higher inorganic N concentrations in soil water samples compared to 2009 treatments. Overall, 2009 yields were twice as high as 2010 yields and water leachate samples in 2009 were roughly half as high as 2010.

Conclusions:

Virginia Extension recommendations should be revised for current fresh market polyethylene mulch tomato production systems to include N rates using different application methods. Current recommendations suggest the incorporated method; however, data suggests the banded method may lower fertilizer losses via leaching and increase yields. Suggesting optimal N rates using the banded method might reduce excess commercial N use and increase fertilizer use efficiency. Additional analysis of residual soil N will determine further fertilizer and monetary inefficiencies. Based on 2009 and 2010 yield data, Virginia Cooperative Extension recommendations should be updated for fresh market polyethylene mulch tomato production systems and increased to 180 to 240 kg N ha^{-1} using the banded application method for maximum yields and fertilizer use efficiency. However, this project needs to be conducted a third year to effectively establish a sufficient database of yield, soil water, and plant data.

III. Goals and Outcomes Achieved

The major objective of this project was to establish a comprehensive nitrogen fertilization plan for fresh market tomato producers in Virginia and all goals to date were achieved. However, we would like to continue the project a third year to further evaluate new production practices. Regarding specific goals achieved, the project was established in 2009 and 2010 as a factorial arrangement of two nitrogen application practices and four nitrogen rates replicated four times, and one control treatment replicated four times, giving a total plot combination of 36 plots per year. Petiole sap nitrate tests and NDVI readings were performed when fruit on the plant was approximately 5 cm in diameter. Collections of soil water samples from suction cup lysimeters were performed weekly throughout the growing season. At the end of the season, fruit was

collected to calculate yield and graded. After harvest, plant and soil samples were collected to obtain biomass and residual soil N.

Completed activities:

All activities to date were completed for this particular project. Concerning specific activities, infrared cameras were used to establish a greenness index and related back to tomato yield. Petiole nitrate samples were also taken to measure plant nitrogen status and yield. Water quality measurements were taken from the 46 cm depth using lysimeters to measure nitrogen leaching through the vadose zone on a weekly basis throughout the growing season. Collected samples were analyzed for ammonium and nitrate colorimetrically using a continuous flow auto analyzer. Yield was calculated by picking tomatoes 3 different times during the growing season and grading fruit into USDA classification of sizes. Yield was regressed against total nitrogen fertilizer applied to derive equations for yield prediction.

Below is a yearly timeline for the comprehensive nitrogen fertilizer project:

- January – Reserve research station land.
- February – Land preparation begins for research plots.
- March to April – Final land preparation will take place and beds will be established. Fertilizer will be incorporated into the tomato beds and fertilizer band added to respective treatments. Drip irrigation installed and bed covered with polyethylene mulch.
- April to May – Transplant tomatoes and install stakes. Installation of groundwater lysimeters.
- May to July – Injection of fertilizer into irrigation water. Tie tomatoes as they grow. Groundwater samples collected. Nitrogen status measurements taken. Plant samples taken.
- July – Tomato harvest and grading of fruit. Presentation of preliminary data to stakeholders at summer field day.
- August – Kill tomato plants, remove plastic and irrigation. Remove lysimeters.
- September to December – Presentation of data to stakeholders at various meetings around Virginia. Updating and writing extension publications.

IV. Beneficiaries

New best management practice information for fertilizer application will be disseminated to a large audience via the Eastern Shore AREC's Agricultural Conference, field days, extension publications, and via visits to other tomato production areas of the state for presentation at stakeholder meetings. Helping producers reduce nitrogen fertilizer use and increase efficiency will satisfy the primary objective of the study. Long-term goals of reducing watershed nitrogen loading can be quickly measured via lysimeter readings and soil analysis, but actual groundwater and waterway concentrations may take five or more years before a reduction is seen.

The primary outcome of this project is to increase fertilizer use efficiencies for fresh market tomato producers in Virginia without decreasing yields. Decreasing fertilizer expense will allow producers to increase their profit margins in tough economic times. Fertilizer prices are exponentially increasing as energy prices increase so more efficient use of fertilizer is necessary. Estimates from fertilizer application savings by producers could be derived to include amounts of natural gas conserved by requiring less industrial nitrogen fixation, amounts of crude oil

conserved by reducing required nitrogen imports from other countries, among other cost estimates.

V. Lessons Learned

As Virginia fertilizer recommendations for fresh market tomatoes grown on polyethylene mulch are outdated, and most current information is based on Florida tomato production, this project is well needed for Mid-Atlantic fresh market tomato production. Observing plant response to various N rates and application methods was quantified by several in-season tests. Some of these tests provided more sound data and repeatability than others.

Suction cup lysimeters did not provide repeatable sample collection throughout the growing season. As the season progressed, fewer samples were obtained from the instruments. By the end of the season, some weeks resulted in no collection of samples. We believe this was possibly caused by clay-sized particles clogging the pores of the ceramic cup of the lysimeters. With clogged pores, a vacuum inside the lysimeter will fail at collecting a water sample from the surrounding soil. The soils we worked on are a sandy loam, and contain approximately 11% clay. Another reason for lysimeter failure is lack of soil water. We followed currently used irrigation regimes by local growers, and as plants progressed they used more water. Therefore, it is possible that producers are only watering enough to reach the tomato roots and not watering in excess to push water and nutrients below the root zone, especially during hot and drought stressed growing seasons. Future research into this area is planned to investigate proper irrigation water regimes for the Mid-Atlantic.

Using a Greenseeker to measure NDVI did not provide repeatable results on tomatoes. This might be caused by a variety of factors. Leaf, stem, and immature fruits are all different colors of green; which absorbs and reflects different wavelengths of light. Although more N should provide a greener plant, and thus a higher NDVI, fruit production may alter this value since fruit is light green and the greenness value decreases as the fruit matures.

Due to weather, 2010 yields were much lower than 2009. The 2010 growing season was one of the hottest and driest summers on record in the Mid-Atlantic. We believe that the harsh conditions were major factors in the reduction of yield as soil moisture was decreased and temperature under black polyethylene mulch reached excessive temperatures (>50°C).

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2.
Project Title: Organic Control of Powdery Mildew in Winter Squash Crops
Lead: K. Smith
Amount: $18,750

I. Project Summary

Virginia farmers who sell organically-grown vegetables have reported rising consumer demand for several different species of winter squash. Some of the more popular varieties are Buttercup, Butternut, Blue Hubbard, Kabocha varieties, Delicata, and Acorn varieties like Thelma Sanders. A primary disease of cucurbit crops in the Eastern U. S. is powdery mildew (PM). Caused by either *Sphaerothea julginea* or *Erysiphe cichoracearum*, the familiar powdery white spots typically appear on the tops of leaves. Winter squash yields can be severely reduced due to this disease. Several synthetic chemical fungicides provide reliable control of PM in conventional production systems. Farmers who grow winter squash organically for sale at local markets do not have reliable controls. A number of biological control products that have some efficacy against powdery mildew have been approved by *OMRl* for certified organic production. These products needed to be tested in winter squash field trials on organic vegetable farms in different regions of Virginia to provide reliable information to growers. Field trials concerning powdery mildew control in winter squash were established in 2009 and in 2010 at nine organic farms and at Virginia State University's Randolph Farm. Seven organic control products were tested on eight different varieties of winter squash at widely separated farm locations during the two year program.

II. Project Approach

In the Spring of 2009, field demonstrations in organic production of winter squash were established at five privately owned farms and at Virginia State University's - Randolph Farm. The following winter squash varieties were planted at each location: Delicata, Kabocha Green - Black Forest, Kabocha Orange - Sunshine, Thelma Sanders Sweet Potato, Buttercup - Burgess and a Hubbard variety called Sibley. The cooperating farmers each received the following organic fungicides to use in controlling diseases that often reduce yields in winter squash crops: Serenade, Sonata, Oxidate and Kocide. Serenade and Sonata are biofungicides which use strains of *Bacillus subtillis* and *Bacillus pumilis* bacteria to control powdery mildew and other fungus diseases organisms. Oxidate and Kocide are natural contact fungicides which are approved by the Organic Materials Review Institute (OMRI) for organic production of winter squash. The cooperating farmers divided their winter squash field plots into four separate zones to test the effectiveness of these four natural disease control products.

There were three unexpected developments in this winter squash project in 2009. About six weeks after the farmers planted seeds in their demonstration fields, we began to see infestations of an insect called the Squash bug. The squash bug, *Anasa tristis*, is common throughout the United States. The squash bug will attack all members of the cucurbit family but are most common on pumpkins and squash. Feeding, via piercing/sucking mouthparts, occurs primarily on the plant foliage. However, late in the season, squash bugs may also feed on fruit. The associated damage symptoms include wilting of leaves and ultimately results in leaves that

appear black or dried out. We used the grant funds to order an organic insecticide called Spinosad. The growers at five of the demonstration locations achieved good control of the squash bugs using the Spinosad but the insects totally destroyed the winter squash crops growing at the trial in Mecklenburg County.

Another unexpected development in this project was the huge interest shown by the growers and by the consuming public in these squash varieties. At our field meetings, we spoke about the organic powdery mildew control products but at every meeting most of the participants were more interested in the seeing and tasting the six winter squash varieties. There certainly were differences in the susceptibility of the different varieties to Powdery mildew. The two Japanese Kabocha varieties: Sunshine and Black Forest resisted the disease very well. Thelma Sanders, Buttercup and Delicata exhibited moderate resistance to PM. The Sibley - Blue Hubbard variety was highly susceptible to PM.

Another unexpected and favorable development was the strong market demand for these winter squash that our cooperating growers found at every location. The winter squash sold well at farmers markets, to local restaurants and to the Whole Foods supermarket in Charlottesville. Dave Robishaw with the Marketing Division of VDACS helped two growers sell their winter squash to the Whole Foods chain. The two varieties that had the highest yields and the highest market demand were the Orange Kabocha – Sunshine and Thelma Sanders Sweet Potato. The only variety that had low yields was Sibley or Pikes Peak. We decided to replace that variety with Butternut in 2010. The Green Kabocha – Black Forest had lower yields and less market demand that the Orange Kabocha – Sunshine. We decided to replace the Green Kabocha- Black Forest with a red winter squash variety from France called Potimarron, in 2010.

In the spring of 2010, field demonstrations in organic production of winter squash were established at nine privately-owned farms and at Virginia State University's – Randolph Farm. The following winter squash varieties were planted at each location: Delicata, Kabocha Orange - Sunshine, Thelma Sanders Sweet Potato, Buttercup – Burgess, Potimarron and Butternut. The cooperating farmers each received the following organic fungicides to use in controlling diseases that often reduce yields in winter squash crops: Serenade, THAT (sulfur), Regalia and Kocide. THAT (sulfur) and Kocide (copper) are natural contact fungicides which are approved by the Organic Materials Review Institute (OMRI) for organic production of winter squash. Serenade is a bacterial fungicide. Regalia is a patented formulation of an extract from the giant knotweed plant (*Reynoutria sachalinensis*). Regalia's mode of action stimulates the plant's natural defense mechanisms to inhibit the development of powdery mildew and other fungus diseases. The cooperating farmers divided their winter squash field plots into four separate zones to test the effectiveness of these four natural disease control products.

The 2010 growing season across the State of Virginia was completely different from the 2009 growing season. In 2010 the months of April and May were unseasonably warm and wet. The months of June, July and August were extremely hot and very dry. Nearly all of the farmers, cooperating in the organic winter squash project in 2010, had problems getting a good stand of winter squash established, in their demonstration plots, after spring planting. The winter squash plants that did come up were never infected with Powdery Mildew (PM). There was no PM to control in the treated fields and there was no PM evident in nearby fields of winter squash and

pumpkins that were not part of the demonstration trials. Powdery Mildew did not make much of an appearance in Virginia in 2010. The hot and dry conditions did not favor the spread of the disease up from the Southern states. Extension personnel and the cooperating farmers searched for Powdery Mildew at three field meetings held in August of 2010 and could barely find any evidence of the disease. There were no differences to be seen in the plots treated with the four natural fungus control products.

The one pest that was very evident in 2010 was the true Squash bug - *Anasa tristis.* Damaging populations of squash bugs developed in every grower's winter squash field plots. The growers tried to control them with Spinosad as they had done in 2009. Unfortunately the Spinosad insecticide which was effective against squash bugs in 2009 was not very effective in 2010. Four of the growers had such severe losses that they did not want to host field day programs. Their field plots were decimated and they did not wish to invite the public to see them.

Because of poor stand establishment, low incidence of Powdery Mildew infection and high infestation by Squash bugs, very little information could be gained from the Organic Control of Powdery Mildew in Winter Squash demonstration plots in 2010.

III. Goals and Outcomes Achieved

The proposed goal of this project was:

To increase the income of family farmers in Virginia through profitable production and marketing of winter squash using organic methods of crop protection.

The proposed measurable outcomes of this project were:

1. In 2011, one hundred Virginia farmers will establish winter squash as a new agricultural enterprise.
2. In 2011, one hundred Virginia farmers will earn at least $1000 net income from profitable sales of winter squash.

Educational programs were implemented to meet this goal and to meet these objectives. All interested persons were invited to attend an educational field meeting at one of these demonstration sites in August of 2009. The locations, dates, times and cooperators were:

Rockingham County on August 5, 2009 at 6:30 pm with Calvin Nolt
Mecklenburg County on August 18, 2009 at 6:30 pm with Mike Gilbert
Chesterfield County on August 25, 2009 at 10:00 am with Andy Hankins
King and Queen County on August 26, 2009 at 6:30 pm with Charlie Maloney
Louisa County on August 27, 2009 at 6:30 pm with George Nolting
Nelson County on August 31, 2009 at 6:30 pm with Gary Scott

Field meetings were also held in August of 2010 as follows:

Rockbridge County on August 10, 2011 at 6:30 pm with Mitch Wapner.

King and Queen County on August 12, 2011 at 6:30 pm with Charlie Maloney
Chesterfield County on August 26, 2011 at 10:00 am with Andy Hankins

At all of these field meetings, participants learned about organic management of winter squash crops, trickle irrigation, disease identification and control, insect identification and control, correct stage of harvest, post-harvest handling and marketing. At four of these field meetings taste samples prepared dishes made from winter squash were served. Over 300 persons attended these educational field meetings.

The Virginia Association for Biological Farming (VABF) promoted locally-grown winter squash at the State Fair of Virginia in the fall of 2009 and again in the fall of 2010. Articles about this winter squash research project were published in the VABF newsletter. Andy Hankins gave a presentation about the project at the 2010 Virginia Biological Farming Conference. Mr. Hankins also spoke to over 30 groups of Master Gardeners about growing winter squash in home gardens.

An Extension Specialist named Wanda Johnson at Virginia State University developed recipes for winter squash including quiche, pizza, squash soup and squash breads. She demonstrated the cooking of winter squash at several public events and provided taste samples to participants.

As a result of these outreach programs, winter squash crops have been established as a new farm enterprise on approximately 200 Virginia farms. The adoption of this enterprise was higher than expected. Yields and marketing of winter squash crops were reduced in 2010 due to adverse weather conditions but the estimated value of winter squash crops sold, as a result of this grant funded project, was more than $25,000.

IV. Beneficiaries

Groups and other operations that gained benefits from this organic winter squash project were:

Members of the Virginia Association for Biological Farming
Virginia Farm Bureau
Members of several local Farmers Market Associations
Over 30 local chapters of Virginia Master Gardeners
Whole Foods produce buyers and customers
Virginia Cooperative Extension – Agriculture Extension Agents
Vegetable growers throughout Virginia, with more than $25,000 new sales in 2010.

V. Lessons Learned

As a result of completing this project, the project staff learned that one single aspect of production of a specific vegetable cannot be easily observed in a field demonstration project. The leadership team was focused on organic control of Powdery Mildew (PM) but that disease was not the most serious production problem for the cooperating farmers in 2009 or in 2010. There was greater threat of yield losses due to feeding damage by true squash bug in both years of the project. The adverse weather conditions of wet soils during the planting season and hot, dry conditions during growing season also superseded PM as a production problem in 2010. The

demonstration project would have been more effective if it had simply been a winter squash variety trial. The project staff could have tested the various squash varieties for susceptibility and resistance to insects, diseases and wildlife damage. The various squash varieties could have also been tested for yield, market acceptance and price sensitivity in retail and wholesale markets. This is actually what happened. The project staff and program participants observed many factors connected with the winter squash crops beyond Powdery Mildew.

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3.
Project Title: High resolution vineyard site suitability mapping of Virginia
Lead: T. Wolf
Amount: $19,750

I. Project Summary

The Virginia wine industry adds 100 to 200 new acres of vineyard per year and much of that increase is due to new producers who are entering the industry. While much of the growth is centered in the northern Piedmont, interest in the Shenandoah Valley, southwest Virginia, and the southern Piedmont is also apparent from the inquiries that originate from these areas. New vineyards must, however, be established in prudent sites to minimize the hazards of winter injury, spring frost, poor soil drainage, and biotic factors. While we have a good description of what constitutes a good vineyard site from a physical and climatic standpoint, we do not have a current means of graphically representing such features to the interested vineyardist. The Virignia Vineyards Association sponsors annual technical meetings to support the continuing education of industry members; however, as a volunteer organization, the Association does not have the human resources to assist those who are in an exploratory phase of vineyard establishment.

Researchers at Virginia Tech developed a Geographical Information System (GIS) for assessment of vineyard site suitability in the late 1990's and distributed over 1400 county-specific maps through the year 2007. The maps showed areas of greater or lesser vineyard suitability on a 30-by-30meter resolution, but were static tools which could not be accessed or manipulated by end users. Further, the data used to develop the GIS maps in the 1990's did not include soils or climate data, which is available today. Due to the outmoded nature of these first-generation GIS vineyard maps, their distribution was ceased in 2008. While many emerging wine regions have contemporary GIS resources for growers, Virginia lacked this valuable tool.

This project revives the effort to provide Virginia growers with a modern GIS resource for viticultural suitability. The objectives of the current project were:

1. To collect existing and new GIS data describing viticultural suitability, and develop statewide favorability / suitability map layers based on the GIS data and expert judgment.
2. Create an internet-accessible website including an interactive mapping application to allow the public to view the viticultural suitability data layers and analyses.
3. Provide a logical basis for the development of future American Viticultural Areas (AVAs).

II. Project Approach

Faculty, staff, and students at the Blacksburg office of Virginia Tech's Center for Geospatial Information Technology conducted the GIS data collection and analysis with guidance from John Boyer, Tony Wolf, and Peter Sforza. Thomas Dickerson oversaw technical details pertaining to data collection and development, and helped prepare the web-based GIS component of this

project. Corienne Reisch, an undergraduate research assistant, helped develop the soil-related GIS layers for use in the viticultural suitability assessment.

The project began with the collection of GIS data relevant to the study, from which viticultural suitability map layers could be derived. Work began with collection and processing of soils data, primarily from the USDA NRCS SSURGO dataset. Individual soil map layers were created for a variety of specific parameters, including Soil Depth, Drainage, Organic Matter Content, Parent Material, Saturated Hydraulic Conductivity, Bulk Density, Available Water Capacity, Surface Texture, and pH. Based on meetings with Dr. Tony Wolf, approximate rankings of soil parameters values were developed for use in the overall suitability analysis. Some of these soil layers are of critical importance, some are potentially limiting, and some are of minor significance.

Climate data was collected from the Oregon State University PRISM climate group, and from the National Climatic Data Center (NCDC) records of weather station observations. PRISM data was used to provide mapping of annual, growing season, and ripening season precipitation. A separate interpolation method was used to create a statewide low temperature injury risk map from the NCDC weather station records.

Statewide terrain data (from the USGS National Elevation Dataset) was collected and used to produce slope, solar aspect, and landform layers.

Finally, data pertaining to other factors, like land cover, was collected.

The interactive web mapping site to display the viticultural suitability datasets was developed in an iterative process, finally stabilizing on the version currently hosted at http://vmdev.cgit.vt.edu/Vineyards/. By using standard ArcGIS Server web map services and geoprocessing services, it was possible to experiment with a variety of user interfaces while relying on the same underlying services. Google Maps was used as the base map for the website, so that the user can view high resolution aerial imagery and roads data when locating their project site. By picking a layer from a drop-down list at the left side of the page, the user can view the viticultural suitability layers on top of the Google Map. Finally, the user can draw a polygon a request a site-specific suitability report.

III. Goals and Outcomes Achieved

The goals for this project were largely achieved; specifically:

- Existing and new GIS data describing viticultural suitability was collected (where available) and created (where necessary). Statewide favorability / suitability map layers were developed based on the GIS data and expert judgment.
- An internet-accessible website was created, which includes an interactive mapping application to allow the public to view the viticultural suitability data layers and analyses.
- By virtue of completing the above objectives, we have helped to provide a logical basis for the development of future American Viticultural Areas (AVAs).

Much of the work on this project will live on in a subsequently awarded multi-state USDA grant "Improved grape and wine quality in a challenging environment: An Eastern U.S. model for sustainability and economic vitality" to further improve grape and wine quality in the eastern United States. CGIT will expand and further refine a new Web-based, interactive geographic information system (GIS) platform to assist in the evaluation of areas of interest in the eastern US for vineyard suitability and match the property's location to appropriate grape varieties primarily based on length of growing season, summer heat, and winter low-temperature thresholds.

IV. Beneficiaries

This project adds to the body of documentation supporting the practice of viticulture in Virginia. Beneficiaries include those who are in an exploratory phase of vineyard establishment, as well as those who help to advise such individuals. Beyond this audience, the website materials have some general educational value for the general public.

V. Lessons Learned

Not all of the viticultural suitability factors that were desired were able to be developed within the budget of the current project.

The site-specific report creation tool didn't reach the desired level of sophistication; the current tool generates the report in the form of an HTML page, which cannot be easily saved / downloaded for offline usage. Work towards a new version of the reporting tool (with PDF output) was initiated towards the end of the project, based on feedback from the users. However, the new version was not completed.

With the awarding of the multi-state USDA grant it is expected that some of these shortcomings can be overcome.

VI. Additional Information

Corienne Reisch presented a poster on this project at the 2009 Virginia GIS Conference in Richmond on September 22-23, 2009, for which she was awarded first place in the student division.

Funding for Mizuho Nita's grape research was awarded in 2011 and will allow for continued development of weather mesonet based disease models in GIS. The results could be incorporated into the viticultural suitability assessment in the future.

The website GIS tool is up and functional, although there are some bugs to work out of the report generating part of the GIS site. The URL for the tool is: http://vmdev.cgit.vt.edu/Vineyards/ I have shared this with the VA industry and we have used it to help evaluate potential vineyard sites. In time, Peter Sforza and his team will add a counter to the site to allow us to record usage. This has been an important "deliverable" from the initial funding provided by the VDACS block grant.

The work that we did in 2009 and 2010 also helped support a larger, eastern US vineyard/variety evaluation project that is included with a USDA Specialty Crops Research Initiative grant that we were awarded last year. The 5-year project, awarded at $3.8M, will include a means of evaluating sites in the eastern US much the same way that we have devised for here in Virginia. Information on the USDA grant can be found here: http://www.arec.vaes.vt.edu/alson-h-smith/grapes/viticulture/research/scri-index.html In a sense, the VDACS grant provided seed funding that allowed us to leverage a much larger, direct federal grant to expand the scope of our work.

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4.
Project Title: Creating Conditions for a Sustainable Commercial Organic Blueberry Operation
Lead: R. Miller
Amount: $18,665.74

I. Project Summary


Duke Highbush Blueberries harvested from Knoll Acres, 2011

Three project motivations:

(1) Increased consumer interest in local blueberries is not matched with sustainable commercial blueberry operations;

(2) increased consumer interest in organic products is not matched with adequate amounts of local organic produce;

(3) an illustrative model of a successful sustained small commercial organic blueberry operation has not been demonstrated in this area.

While Rockingham County in the Shenandoah Valley of Virginia is a major locus of agriculture, poultry and dairy operations have provided the major sources of income for farmers. More recently some farmers have diversified their operations by including some specialty crops in order to provide an additional source of income. A variety of specialty crops – vegetables and fruit – have been successfully raised and marketed in local retail and wholesale markets. However blueberry production has been less successful and frequently attempts to initiate a small commercial blueberry operation has not been economically sustainable.

Project goal: Overall project goal is to create and document the development of a model system of specialty agriculture by forming and sustaining a small commercial organic blueberry operation in the Shenandoah Valley. Three sub goals included (1) finding best practices in developing an organic versus a conventional blueberry operation, (2) documenting the economic benefit of a sustainable blueberry operation and (3) providing opportunities for undergraduate students at Eastern Mennonite University to participate in horticultural research projects.

II. Project Approach

In 2009, we established two plots of highbush blueberries (organic versus conventional) involving five different cultivars (Duke, Bluecrop, Jersey, Bluegold, and Chandler) planted in soil plots amended with one of four treatments: horse manure/sawdust, sheep manure/hay; pine needle; and Planters choice composts. We monitored changing soil profiles by annual assessment of macro- and micronutrients, pH values, percentage of organic material, and soil respiration and monitored plant vigor via plant growth data, foliar analyses, photosynthesis and transpiration activities, and ultimately berry production.

Best horticulture and sustainable practices for blueberries were illustrated by installation of a drip irrigation system that uses stored rainwater as a primary source and the installation of bird/insect netting system to protect ripening blueberries from predation. Economic benefit is based on start-up and continuing production expenses including labor cost estimates that ultimately are to be balanced against income derived from the marketed berries. Since the summer of 2012 will be the first marketable harvest, early cost/benefit analyses and projections will need to wait until that season is completed.

III. Goals and Outcomes Achieved

Five project goals were identified in the original proposal and are repeated below in *italics.* .

1. *Illustrate, promote and publish this small commercial organic blueberry production as a model system of a sustainable specialty crop that has economic viability within the expanding small farm diversifications and initiatives of farming in the Shenandoah Valley of Virginia.*

System Design. Organic and conventional blueberry plots were designed and cultivated during the fall of 2008. The rows were treated with compost, soil amendments, and cultivated during 2009. In November and December of 2009, 160 three- year old bare-rooted blueberry plants representing five different cultivars were planted in the organic and conventional plots (Table 1).

Table 1. Blueberry cultivar planting and soil treatment plots

Soil Amendments Added	**Mulch Type / Style**	**Conventional Blueberries: number plants [number cultivars]**	**Organic Blueberries: number plants [number cultivars]**
Horse Manure compost	Pine bark mulch / high raised beds	0	28 [5]
Horse Manure compost	Pine bark mulch / mounded beds	19 [5]	26 [5]
Sheep/Goat Manure compost	Pine bark mulch / high raised beds	0	24 [5]
Sheep/Goat Manure compost	Pine bark mulch / mounded beds	0	23 [5]
Pine Straw/Bark compost	Pine bark mulch / mounded beds	0	23 [4]
Planters Choice compost	Pine bark mulch / mounded beds	0	36 [5]
		19 total	160 total

During 2010, several plants were replaced and a few additional plants were added to the ends of the rows bringing the total number of blueberry plants to 196 at the end of July 2011.

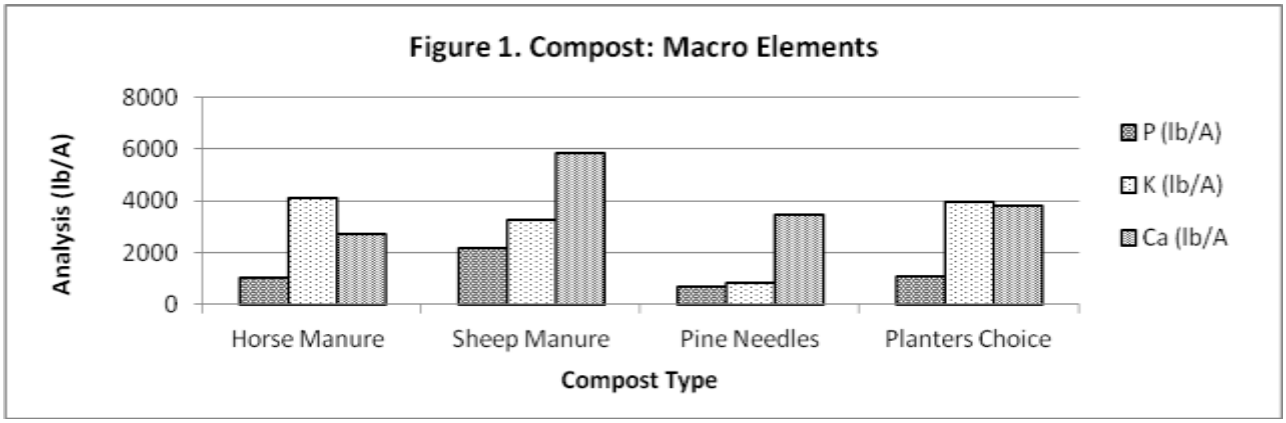
A website (www.knollacresblueberries.com), designed by the project director, was functionally on-line in September 2009. This site is periodically updated with information about on-going projects and interim reports. The website is currently operational and primarily focuses on the preparation portion of this project and early findings. Frankly, it needs updating with more information about plant pathologies that I have encountered as well as harvest information. My goal is to update the website in August after our 2012 harvest is ended. During the past several months the website received an average of over 1,000 unique visitors per month. This indicates the interest of blueberry growth and production by many people. Periodically, I receive inquiries from individuals who are interested in blueberry growing. Most of those are generated because of the website.

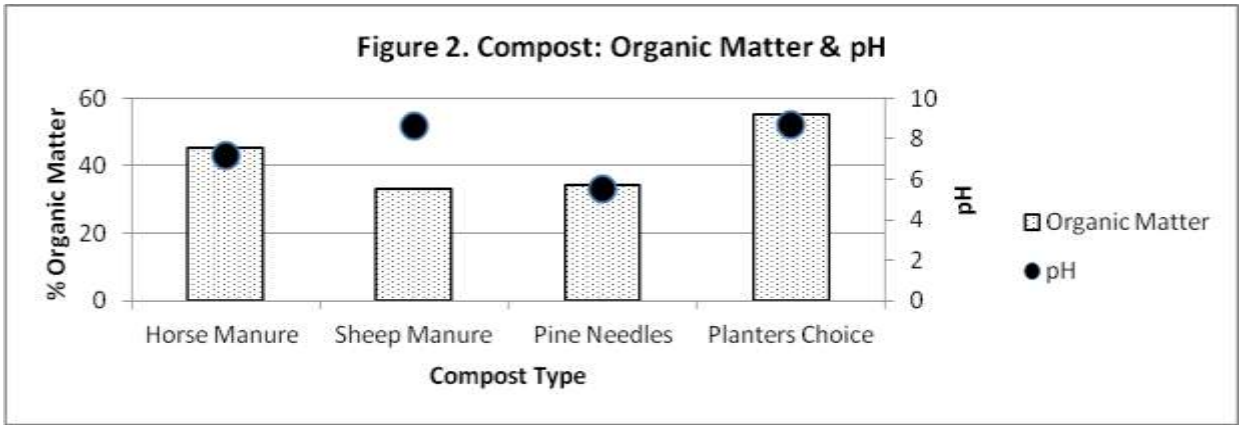
This goal has been achieved through the promotion of the website, phone conversations, email correspondences, and visits by individuals interested in growing local blueberries. Additionally publications and presentations by the project director and student researchers have

provided additional outlets of information. More manuscripts are in preparation and will be submitted for publication in 2012 following the harvest season.

2. *Determine, detail, and publish the best organic practices in developing a blueberry operation including soil preparation and enhancement, predation and insect control, selection, maintenance, and productivity of cultivars, selection of fertilizers and mulch, usage of low-raised bed borders, and control of weeds and plant diseases.*

Selected Compost Parameters. During 2009, two applications of compost were added to the organic and conventional plots. The four types of compost were: Horse manure, Sheep manure, Pine needles, and Planters choice. All four composts were rich in basic nutrient macro elements. Sheep manure was the highest in phosphorus and calcium, while horse manure was highest in potassium. See Figure 1. As expected the organic matter was high in all composts ranging from 33% in Sheep manure to 55% in Planters Choice. The pH was elevated in both the Sheep manure and Planters Choice composts (pH = 8.6 & 8.7 respectively) which created the undesirable effect of raising the soil pH. See Figure 2. In an attempt to reduce soil alkalinity (i.e. decrease pH) several applications of elemental sulfur were applied which promoted the desired effect.

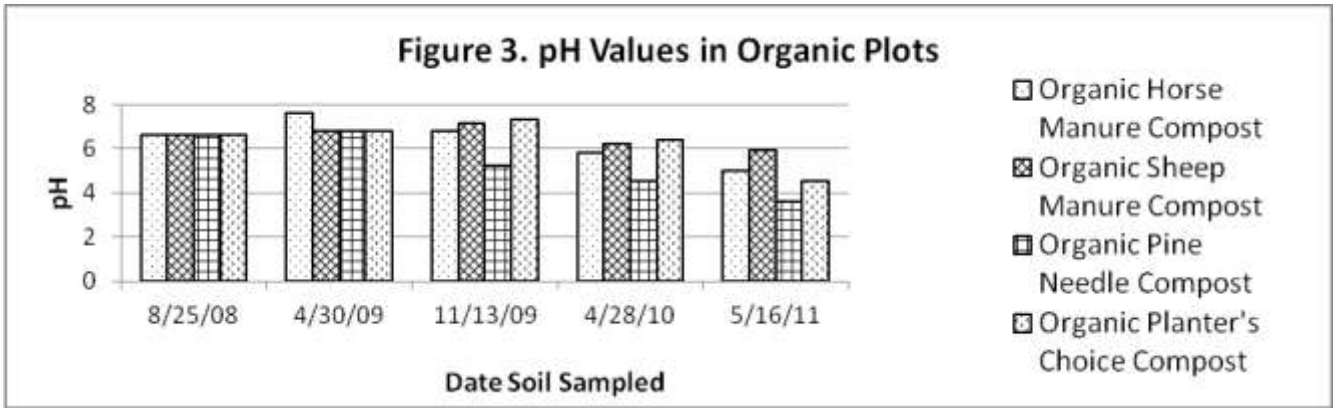


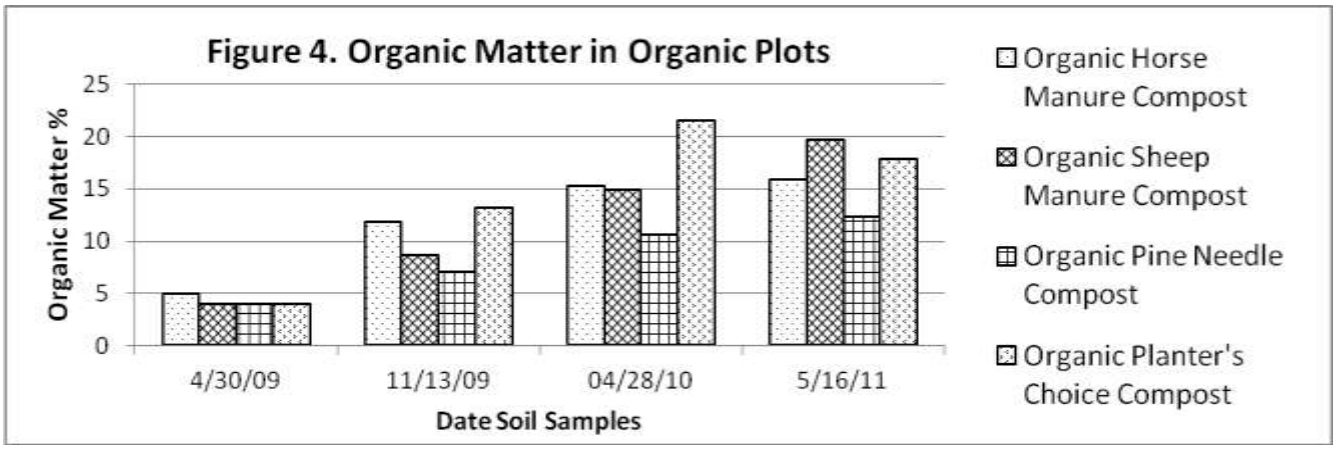


Additional compost micro elements were also quantitatively assessed including zinc, manganese, copper, iron, and boron. All of these values (data not shown) were in the very high or sufficient range with no deficiencies noted.

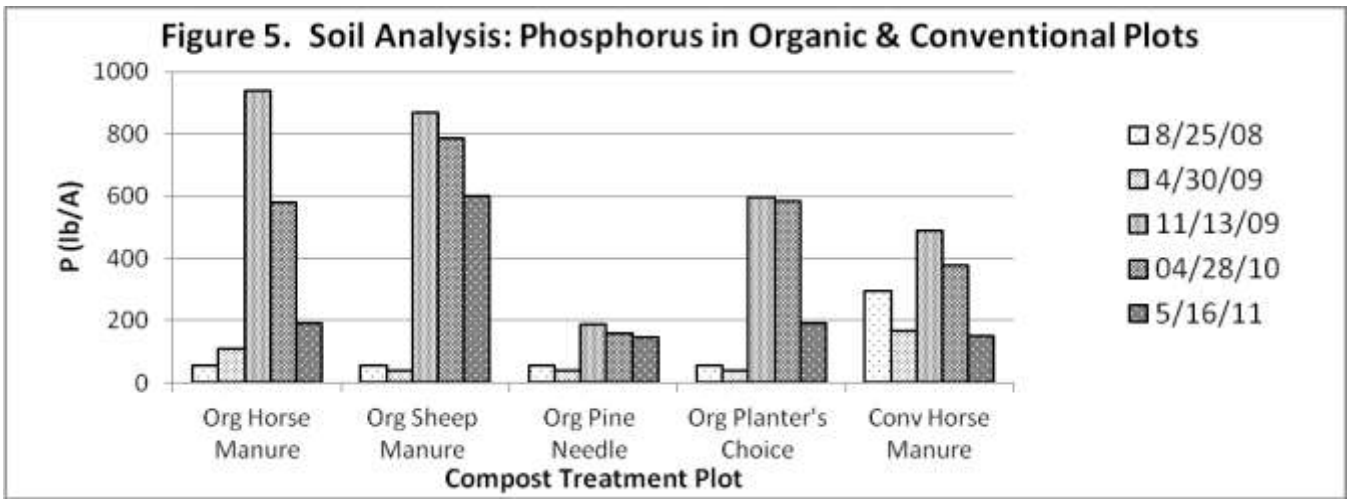
Selected Soil Parameters. In 2008, when we designed our blueberry plots and marked the placement of the rows, we knew that the soil needed amendments in order to grow blueberries. Thus adding sulfur to lower the pH, composts to increase the organic content, and fertilizers to enhance the macro- and micro element content of the soil plots were priorities. We also periodically took soil samples from each plot for analyses and to record changes over time. These samples were taken yearly except for 2009, when two samples were taken before and after the addition of soil compost treatments.

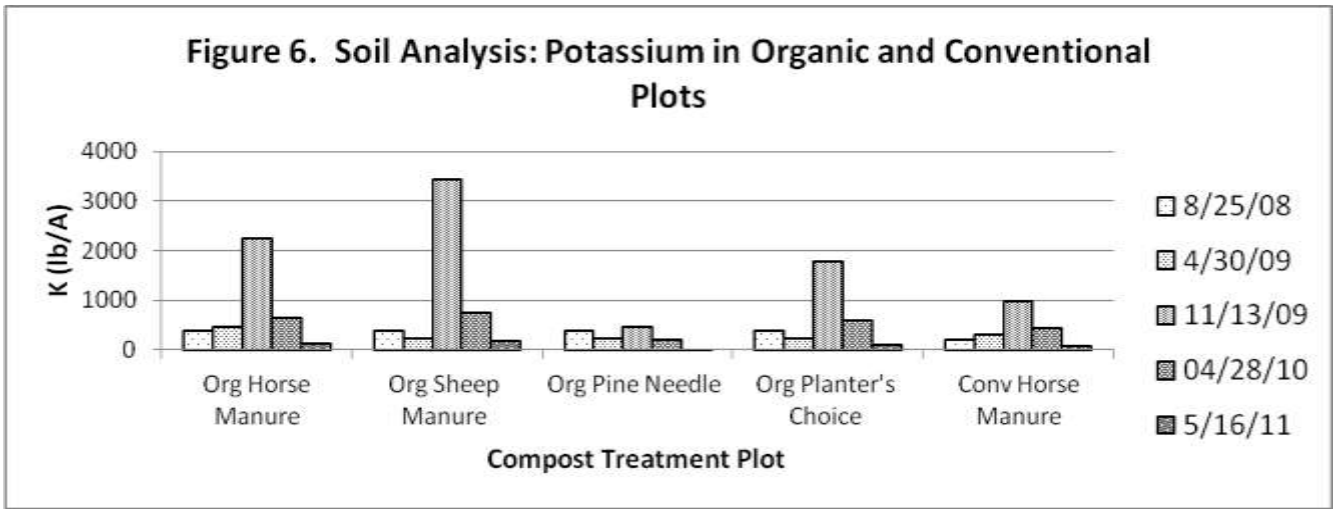
Over time the pH values in each plot decreased so that by 2011 the average pH values was a bit below 5; the sheep manure plot still had an elevated pH that was almost 6. See Figure 3. In response I will add another sulfur treatment to this plot late this summer. The organic content of the soils also increased over time from an average of a little less than 5% to an average of 15%. The lowest organic matter content was in the Pine needle plot. See Figure 4.

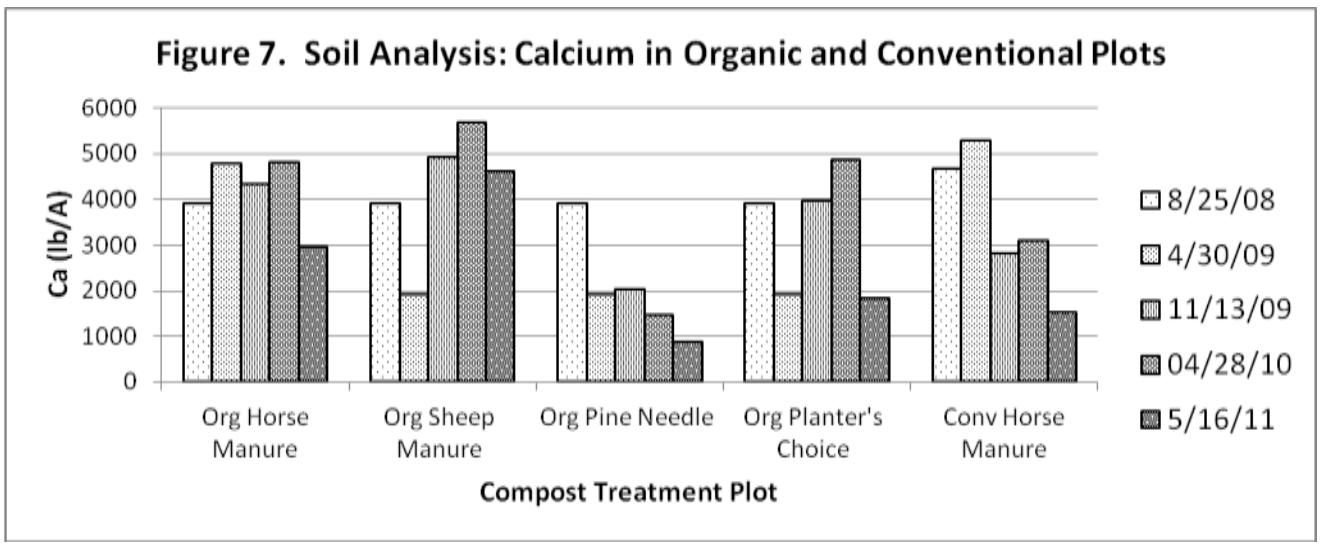




The basic soil elemental macro nutrient content was very high to sufficient in all cases. Fluctuations in the essential elements of phosphorus, potassium and calcium were seen. See Figures 5, 6, & 7. However even at the lowest values, their content was sufficient. The microelements—zinc, manganese, iron, copper, and boron—were all in high or sufficient quantities based on the five testing periods.

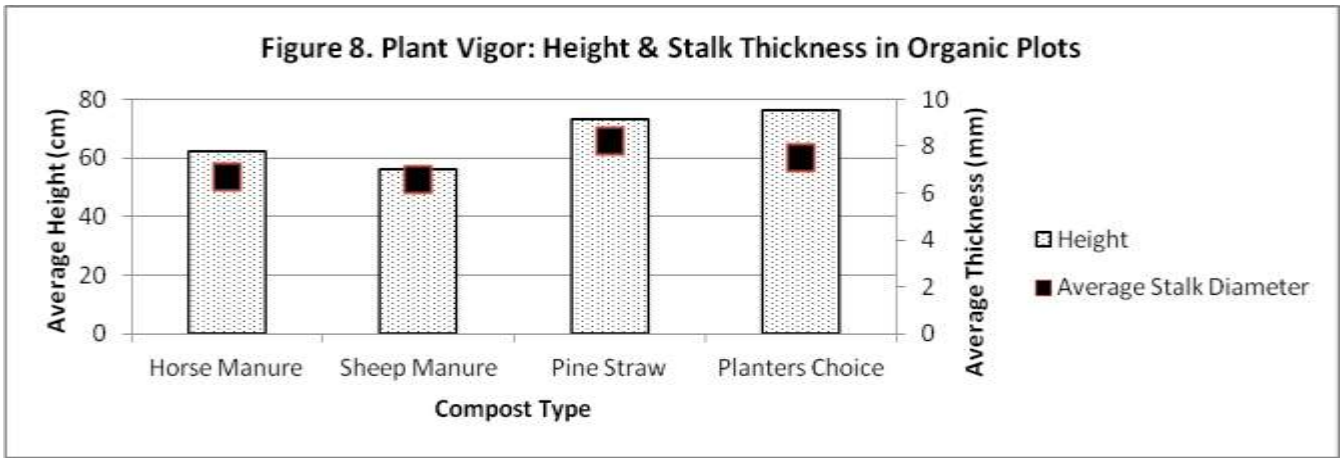


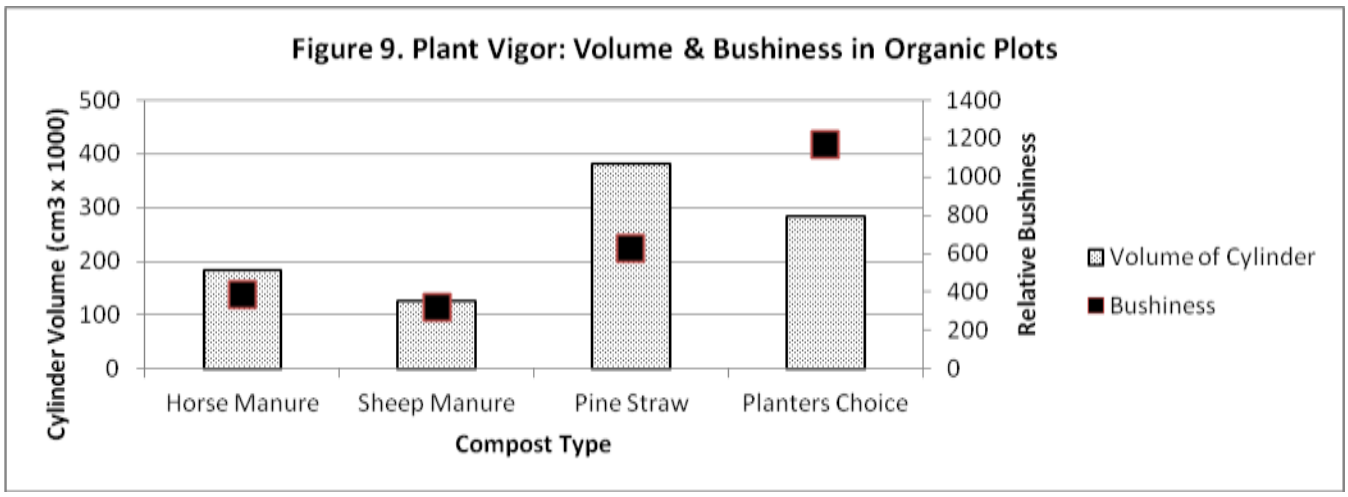




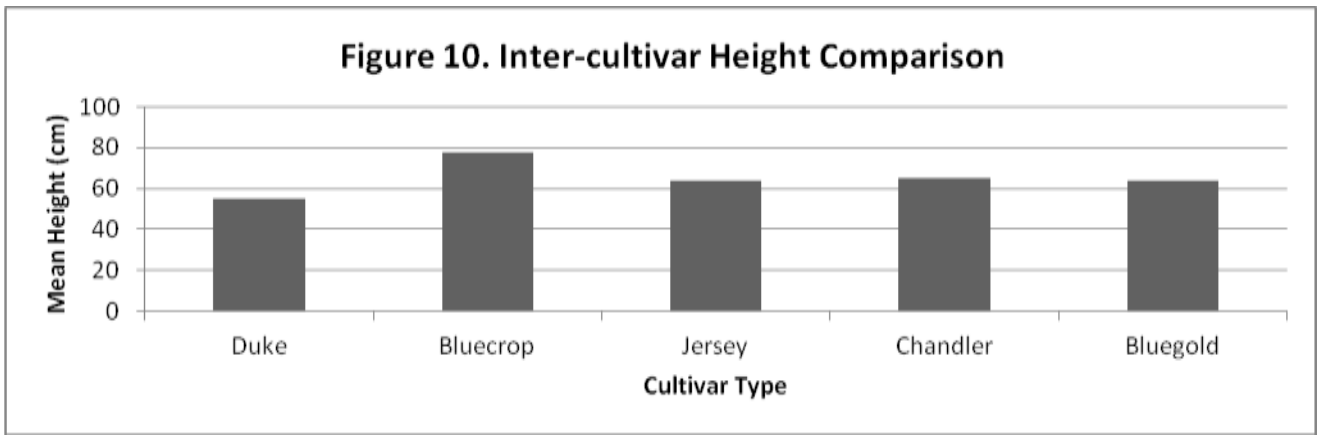
Selected Plant Vigor Parameters. One measure of early plant productivity is the vigor or health of the plant. This past year we determined a variety of direct plant growth measurements

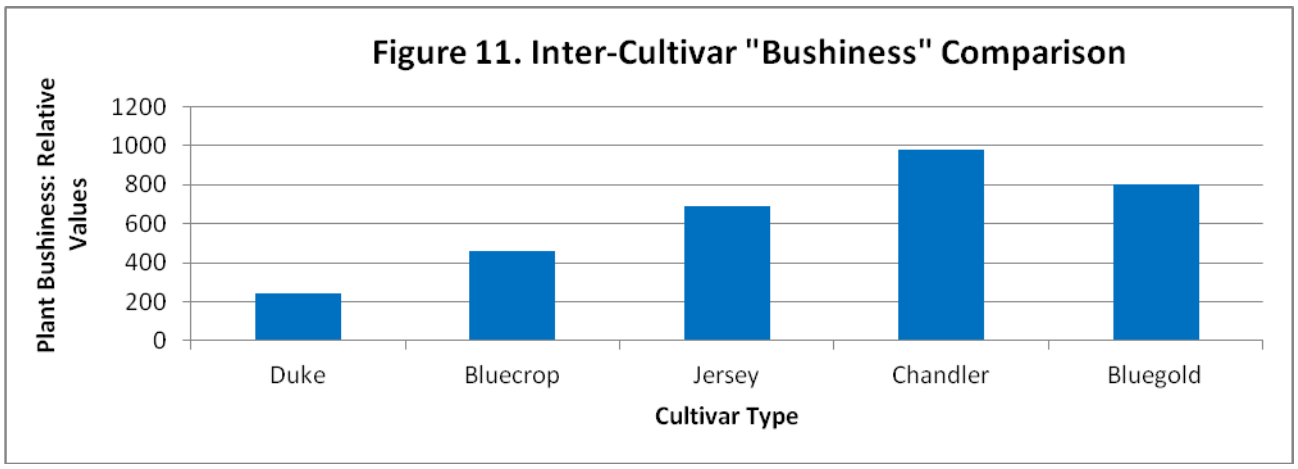
including plant height, stalk thickness, plant cylinder volume (a three-dimensional quantification of plant size) and a relative value called bushiness. Bushiness was calculated by multiplying the number of primary plant stalks by the number of primary branches from a plant stock by the primary stalk height. These values were analyzed based on variations in compost soil treatments and cultivar differences. The Pine needle and Planters Choice compost treatments had the greatest plant heights, the largest stalk diameters (see Figure 8), greatest plant volumes and bushiness (see Figure 9) over the horse and sheep manure treatments.

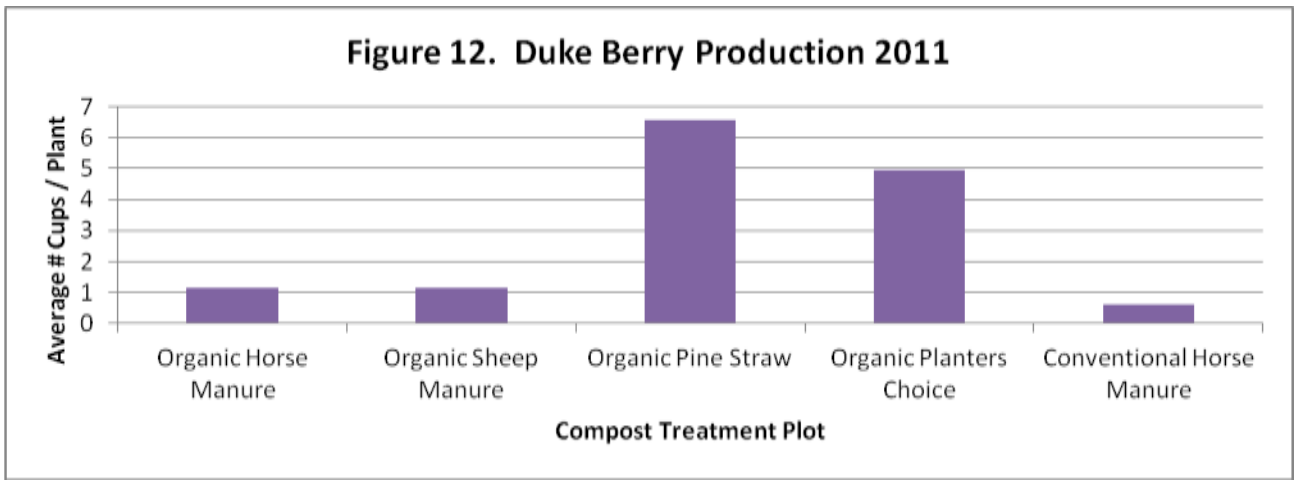




In assessing differences in plant vigor by comparing results from the five cultivars, Blue crop bushes were significantly taller than any of the other cultivars (Figure 10), while the Chandler bushes had the greatest amount of bushiness (Figure 11).







Measures of Productivity: Berry Production. The summer of 2011 was the first harvesting season for our blueberries. Although the blueberry bushes were small, most of them were loaded with flowers in the spring which developed into mature fruit. We harvested about half of the fruit. The early blueberries, Duke, were practically all harvested, while the mid-season cultivars – Jersey, Blue Crop and Blue gold – were about one third harvested. Measurement of the Duke harvest is seen in Figure 12 which includes amounts picked and projected. The figure illustrates the variation of harvest in the various soil compost treatment

plots for Duke. Those trends were generally characterized by the other cultivars. Due to the fact that during the second week in July birds came and removed the rest of the crop, total yearly production was estimated. Based on early returns, cultivars growing on the Pine needle and Planters choice compost plots were producing much better (about 2-3 times greater quantities) than the same cultivars growing in the Horse manure and Sheep manure plots. The Organic Horse manure plot outperformed the Conventional Horse manure plot by over 50% yields. The average bushiness of blueberry plants corresponded with average berry production in the 2011 harvest season (See Figure 13).

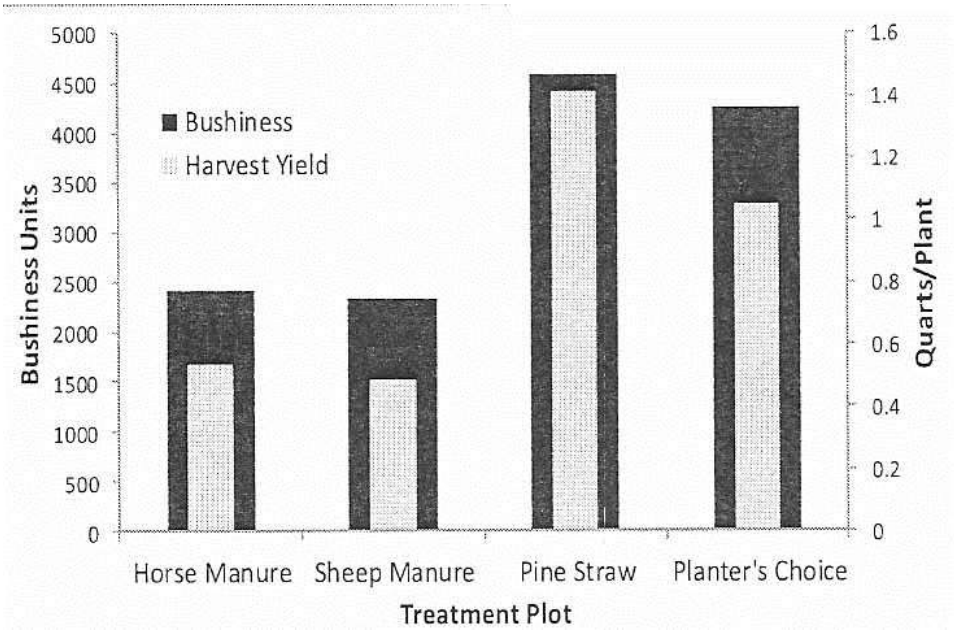


Figure 13. Average blueberry plant bushiness contrasted with average blueberry harvest yield for summer of 2011.

While this entire project involved using only approved organic practices associated with soil preparation, fertilizers, insecticides, etc, the organic plot has been in transition from conventional usage to organic. In the summer of 2011, we received verification of organic certification from Global Organic Alliance. (http://www.goa-online.org/index.html) Consequently, we are now authorized to sell our 2012 blueberry crop as a certified organic crop.

3. *Install a hoop (high tunnel) system over a portion of the blueberries to determine effects on productivity and costs in contrast with non-hoop plants.*

The high –tunnel proposed to be erected over a portion of the blueberry plot was not done. The steep angle of the hill created a maintenance structural problem for a high tunnel system. I also discerned during the first year that it is impractical with the available space to introduce another factor into an already complex system designed to analyze soil treatment differences and responses of five different cultivars.

4. *Control bird predation with the installation of netting system and provide supplemental water with a sustainable drip irrigation system that uses both collected rainwater and well water.*

The drip irrigation system was initially installed in the spring of 2010 and was used both in the

2010 and 2011 seasons. At this point about half of the water used is derived from rainwater and the balance is obtained from a deep well. The goal during the next two years is to increase the relative proportion of rainwater in this drip irrigation system by adding additional storage tanks.

Support wires for the netting system were installed in the spring of 2011; the netting—a combination insect and bird netting fabric was located and purchased. Due to the small size of the plants in the summer of 2011 and the expense of the netting which has a finite life of 7-8 seasons, I decided to NOT net the blueberries during the first harvest season (summer of 2011). The consequence of that decision was that we harvested about 50% of the berry crop while the birds consumed the rest even with the use of scare tape and visual alarm devices. Since the harvest was small, the berries were simply frozen for personal use and shared with friends. No berries were commercially marketed. The netting will be installed prior to the 2012 harvest season which will enable us to obtain a marketable crop.

5. *Provide academic educational experiences for undergraduate students in sustainable agriculture through summer practicum projects.*

During the 2 year span of this proposal, six undergraduate students in biology or environmental science from EMU based their independent research projects on a portion of this grant project. Following is a listing of these students and their general research project topic.

- Jeremiah Valloton (2009-2010) Soil science profiles
- Allison Glick (2010) Foliar analysis of micronutrients in blueberry plants
- Denay Fuglie & Braydon Hoover (2010-2011) Blueberry plant vigor assessments as a consequence of cultivar and soil treatment
- Travis Riesen (2011-continuing until 2012) Blueberry plant vigor assessment and soil profile characteristics
- Jonathan Fretz (2011-continuing until 2012) Foliar analysis of micronutrients in blueberry plants: assessment of soil treatments and cultivar differences.

IV. Beneficiaries

The beneficiaries of this project fall into two categories: student researchers and area farmers/horticulturalists involved in blueberry production. For the student researchers, publications and presentations reflect how they benefited from their involvements. For area farmers, information shared through the website (www.knollacresblueberries.com) and through one-on-one communications primarily through emails or phone calls reflect the significance of this project.

The Project Director received an invitation to attend and make a presentation at the 12th Annual Future Harvests Conference sponsored by CASA on "sustainable blueberry production." This presentation provided another way to share initial findings from this project.

V. Lessons Learned

Plant pathologies have been a continuing challenge. During the first growing season, we saw some defoliation and plant die back on some of the blueberry bushes that had originally been planted in the fall of 2009. Two plants were removed and sent to the Plant pathology laboratory at Virginia Tech. An indefinite diagnosis was return; an opportunistic fungus was found, but something else was creating stress for these plants. Later in the season, September, I sent another two bushes to the Plant pathology laboratory at Michigan State University. They returned a diagnosis that there was some nutrient burn on the plant presumably from soil being too rich. They also found some opportunistic fungi on the plants but did not think that the fungi were the cause of the plant stress. In these cases most of the affected plants were Jerseys which were planted in the Sheep manure plot; a couple of Duke plants were also affected as were one Blue Crop and a Chandler. I ordered some replacement plants – these were potted plants in late 2010. We used these plants to replace the removed plants and also to fill out the ends of several of the rows that were not completely filled with the first planting.

During the spring of 2011, I applied two treatments of Regalia, an organically approved fungicide, on the organic blueberries during the time they were in the bud and early flower stage. For the conventional blueberries I applied two treatment s of Daconil, another fungicide (not approved for organic production). I thought these applications might be prophylactic in preventing fungi stress on the blueberry bushes.

During the spring of 2011, I again saw selected examples of foliar discoloration (yellowing) and foliar and fruit dieback. I again removed two entire bushes and sent them to Virginia Tech Plant Pathology Lab for diagnosis. The one bush had an encircling root which they cited as the cause of the problem; their diagnosis was "girdling roots"; for the other samples their response was that no pathogens were found on the branches and leaf samples. Their diagnosis for these samples were too "deep planting" and on a "cultural problem" that could not be diagnosed from the sample.

Another plant pathology example was discovered later in which a portion of another Jersey bush in the Planters choice compost plot suddenly developed dead brown leaves and shriveled up fruit while the balance of the bush seemed healthy. My "self-diagnosis" of this bush seemed to match the symptoms of Botryosphaeria stem blight. See the photograph above which shows both the "brown" and "green" portions of this blueberry bush.

Student researcher participation has been mixed. An initial student research J. V. who was focusing on soil analysis and who did much of his work in the 2009-2010 academic year has been negligent in completing his data analysis in preparation for a referred manuscript. Despite promises, nothing has been forthcoming from this student. In contrast another student, A.G. who did initial work on developing a foliar assay during the spring of 2010 has now completed her work so that it will soon be ready for publication in a peer reviewed journal. The challenge from my perspective is to keep the student researcher engaged and focused with manageable deadlines for different project aspects. That is easy for some students and much more challenging for others.

Project management. This has been a great challenge for me as the project director. It has taken a lot of energy and time to monitor and train the various student researchers who have participated in the project. Students greatly vary; some apply themselves with vigor and are self-motivated; others require a lot of mentoring and "encouragement" to complete their work and to write it up in a format that is potentially publishable.

Project accounting. An important aspect of this project is to demonstrate the economic feasibility of a small scale commercial organic blueberry operation. That goal has required extensive record keeping to establish the start-up costs. Since we have not yet marketed any of the berries, this has been a negative cost. However, beginning with the marketing of the crop from the summer of 2012, we should begin to cover some of these initial expenses. Consequently the barometer of cost-effectiveness should be clearer following the 2012 and 2013 harvests. At this point it is premature to suggest that this project is cost-effective.

Organic certification. I didn't adequately anticipate the extra expense, labor, and effort that is required to obtain organic certification. Consequently this has required a lot more time than I had initially allocated. However, I was gratified to receive that certification this past summer. Time will tell whether organic certification is cost-effect in the marketing of organic versus conventionally grown blueberries.

Issues in horticulture. Although we have had blueberry plants in our home garden for many years, this planting of about 200 blueberry bushes has magnified the problem issues that confront a horticulturalist—ranging from bird predation, weed control, fungal infestations, nutrient deficiency, and other plant pathologies. I have learned a lot about treating pathologies and the importance of preventative strategies to control potential pathologies.

Blueberry horticulture is very challenging but enjoyable. I have immensely enjoyed the times I've spent learning more about blueberry horticulture as well as organic versus

conventional agricultural techniques and issues. Harvesting beautiful blueberries and sharing them with friends is a "real high."

The portion of the grant proposal that included the attempt to demonstrate economic viability (a portion of specific project goal #1) with this small model system has not been completed. The non-completion is primarily an issue of timing within the period of the grant. The grant goal was to show a cost/benefit analysis as part of this model system. While that goal continues, it was not possible to obtain adequate data during the early years of the project.

Our blueberries were planted as bare-rooted three year old plants in the winter of 2009. The first summer of 2010 was a non-harvest year. This past summer of 2011 was a partial harvest year and was the first year that we could measure actual and projected projection. The projected production was estimated when bird predation removed about half of the late blueberry crop. To not net the blueberries during 2011 was an economic decision made early in the harvest season when bird predation was low and the overall per bush berry production was not great enough to warrant attempting to market the berries. The decision factored in the cost of the netting versus the finite life of the netting (estimated at 7-8 seasons). Consequently I decided to store the netting for the first year and use other methods to minimize bird predation – scare tape, balloons, etc. Clearly these methods were not effective in deterring bird predation. Consequently a significant portion of the 2011 crop was lost.

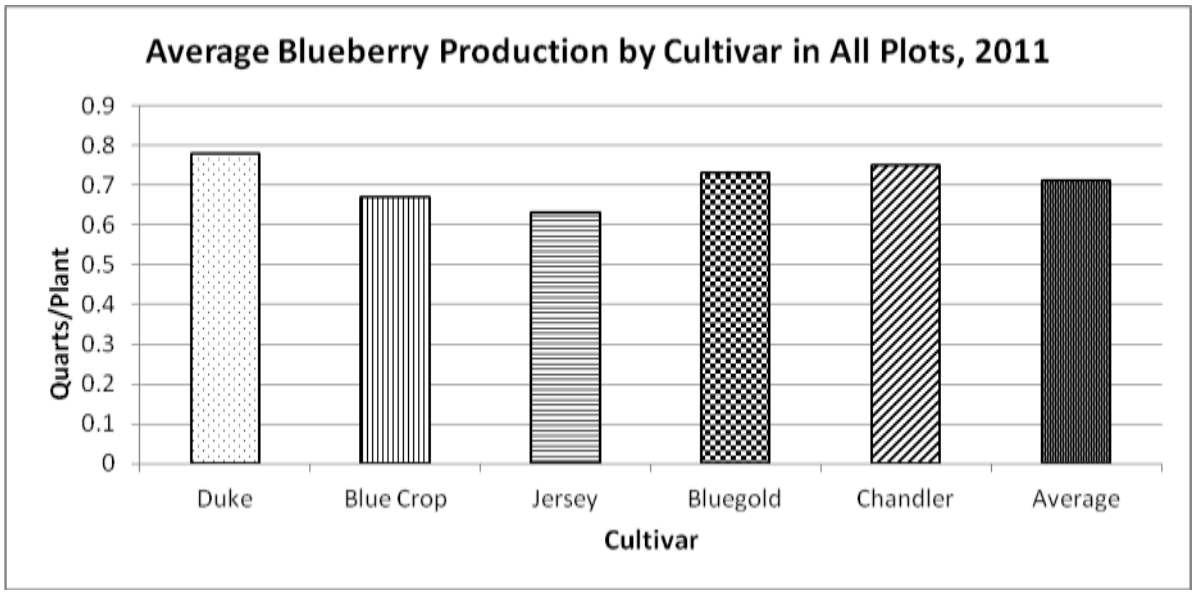
Considering the harvest data from 2011, it seemed clear that one datum point (or one harvest season) while indicative of a potential trend, does not a trend make. Without harvest and sale data, it becomes highly speculative to estimate cost/benefit outcomes. Consequently, this portion of the project has been delayed until a couple of harvest seasons are completed.

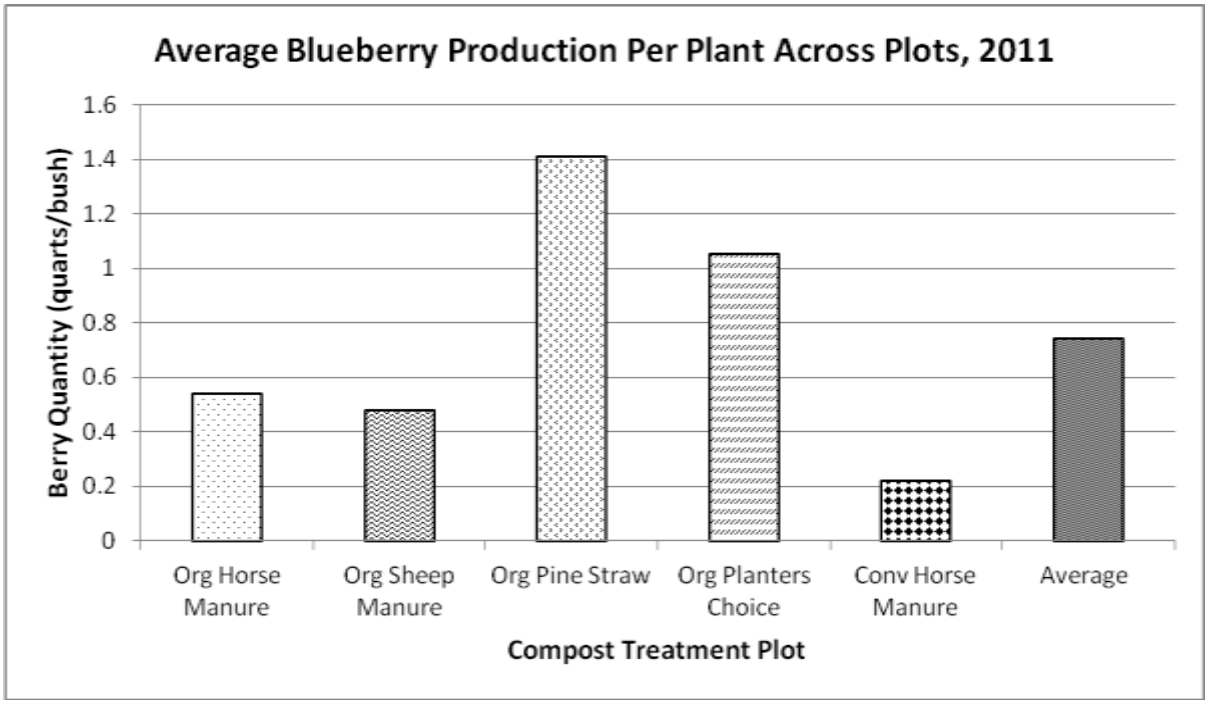
Our continuing plans are to monitor yield quantities from the various soil treatment plots and from the five different cultivars as well as income from wholesale and retail sales for the 2012 and 2013 harvests. On the basis of these data, we can much more accurately describe the potential cost/benefit of raising blueberries in the Shenandoah Valley of Virginia.

While the 2011 harvest was incomplete and partially estimated, the preliminary data indicated potential trends as seen on the following two graphs:

- Assessment of specific cultivars
    - The order of Duke, Chandler, Bluegold, Bluecrop, and Jersey represented descending quantities of berry production per plant across all soil treatment plots.
    - The size of Duke and Chandler berries (earliest and latest) was greater than the other cultivars
- Assessment of soil plot treatments on all cultivars
    - Organic pine straw and organic planters choice compost plots had significantly greater per bush yields than the other plots
    - On per bush basis, the organic horse manure plot yield was greater than double the conventional horse manure plot yield

I emphasize that these potential trends are only suggestive and need verification with subsequent season yields before I would attempt to publish these results.


Average Blueberry Production by Cultivar in All Plots, 2011
Quarts/Plant
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Duke
Blue Crop
Jersey
Bluegold
Chandler
Average
Cultivar


Average Blueberry Production Per Plant Across Plots, 2011
Berry Quantity (quarts/bush)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Org Horse Manure
Org Sheep Manure
Org Pine Straw
Org Planters Choice
Conv Horse Manure
Average
Compost Treatment Plot

Lessons learned from the economic data at this project stage

- Soil preparation and planting costs in comparing conventional versus organic blueberry differ in that organic production startup costs are at least 50% higher than conventional costs. This is due to increased expenses in organic versus conventional fertilizer, costs of organic certification, increased time required for organic plant care, especially the hand weeding that was needed.
- Economic sustainability cannot occur in the short-term with a startup blueberry production. Consequently within the short-time frame of this grant, economic sustainability cannot be verified. However during the next two harvest seasons, as the bushes continue to mature and their productivity substantially increases, I believe project data can verify that a small blueberry operation can be economically sustainable.
- Based on preliminary cost/benefit data, it is not possible to demonstrate that organic production is superior to conventional production (or vice-versa) due to two confounding trends: (1) the startup costs for organic exceeds startup costs for conventional blueberries; (2) early production of organic blueberries exceed the production of conventional blueberries.
- Finally, I do not know whether retail buyers of blueberries are willing to pay a price premium for organically certified blueberries over conventional blueberries. I will discover that trend during the harvest sales in 2012 and 2013.

VI. Additional Information

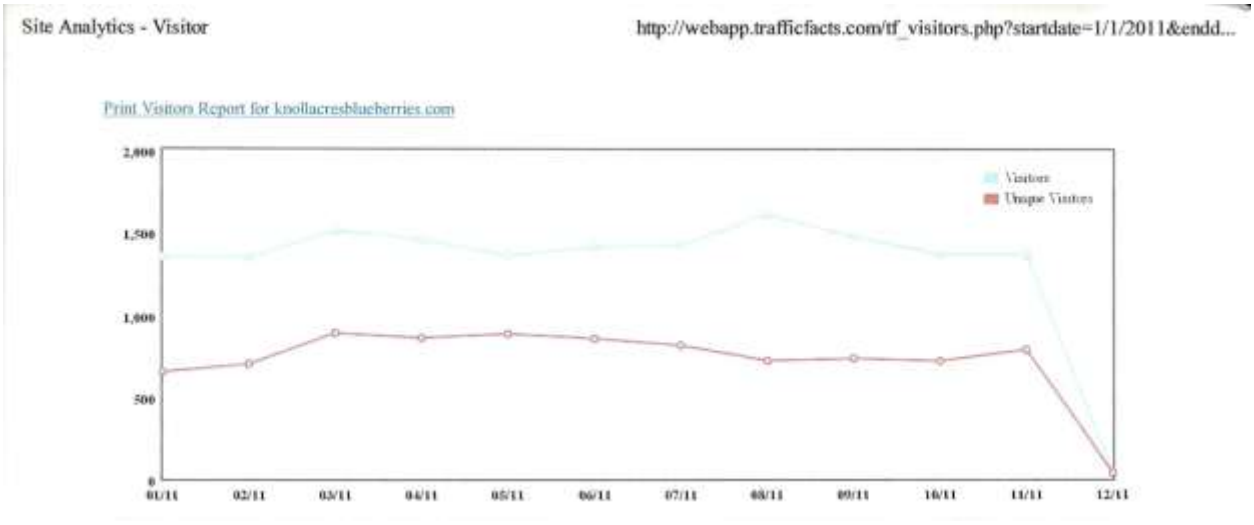
Research Student Publication/Presentation Outcomes:

- Two student research presentations at Virginia Academy of Sciences 88th Annual Meeting, Agriculture, Forestry, and Aquaculture Division, May 21, 2010, held at James Madison University:
    - Jeremiah Vallotton and Roman Miller, "Effects of Different Organic Applicants on Soil Conditions for Blueberry Production."
    - Allison Glick, Denay Fuglie, Braydon Hoover, and Roman Miller, "Foliar Micronutrient Analysis for Organic Highbush Blueberry Production."
- One student research presentation at Virginia Academy of Sciences 89th Annual Meeting, Agriculture, Forestry, and Aquaculture Division, May 26, 2011, held at University of Richmond.
    - Braydon Hoover, Denay Fuglie, and Roman Miller, "Optimal Growth Conditions across Organic Blueberry Cultivars and Soil Treatments."
- One student research paper published.
    - Allison Glick, Matthew Siderhurst, and Roman Miller, 2011. "Method Development for Elemental Analysis of Foliar Blueberry (Vaccinium Corybosum L.) Samples," *Journal of Undergraduate Chemistry Research*, 10(4): 178-181
- EMU Campus Wide presentation for the Fall Student Project and Research Symposium, Friday, December 9, 2011. Travis Riesen and Jonathan Fretz, "Organic and Sustainable Blueberry Horticulture."

- One student research poster presentation submitted for approval to Council of Undergraduate Education, Washington, D.C. "Posters on the Hill" Competition, for April 2012. Travis Riesen and Jonathan Fretz, "Sustaining Organic Blueberry Production: Analysis of Practices and Assessing Outcomes."

Other Publications/Presentations/Promotions by Project Director

- Conference Presentation: Roman J. Miller, January 15, 2011, "Experimental Approaches to Sustainable Blueberry Production," at the Future Harvest CASA 12th Annual Conference, Pearlstone Conference Center, Reisterstown, Maryland.
- Website: www.knollacresblueberries.com
  - This active website monitors and describes on-going findings and outcomes from this project. Maintaining and continuing upgrading requires a significant outlay of time and effort.
  - During the past twelve months, the number of unique visitors to the site has ranged from 650/month to 880/month; the total number of visitors during the past twelve months averaged about 1400/month.
  - Since the website contains contact information, I've received numerous email inquiries especially during the past 9-10 months with questions about blueberry horticulture, pathogen identification, plant pathology, productivity and berry quality, etc. I've attempted to respond to all inquiries provide information as I understand it, but being careful not to overstate what I don't understand. For example, I am actively learning about blueberry plant pathology and have greatly benefited from the advice of seasoned blueberry growers as well as information from blueberry conferences.



The above graph taken from Site Analytics, graphically illustrates the number of visitors to the knollacresblueberries website.

Publications Planned and in Process

The following three manuscripts are currently in preparation. Dates in parentheses are target dates for submission to the respective journal or magazine.

- "Determining Initial Optimal Growth Conditions across Organic Highbush Blueberry Cultivars and Soil Treatments" by Braydon P. Hoover, Denay M. Fuglie, Travis Riesen, and Roman J. Miller. In preparation for submission to *HortScience* (July 2012)
- "Sustainable Soil Preparation for Organic Blueberry Production" by Roman J. Miller. In preparation for submission to *Farming Magazine* (June 2012)
- "Creating Conditions for a Small Commercial Organic Blueberry Operation: Early Learnings" by Roman J. Miller. In preparation for submission *to Countryside and Small Stock Journal* (August 2012)

Final Budget: 2009-2011

EMU SCVDACS Grant	Grant Total	Budget Total	Variance
Wages:			
Project Director	3,399.95		
Student Stipend	4,055.38		
Fringe Benefits	1,425.52		
Total:	**8,880.85**	**11,800.00**	**(2,919.15)**
Supplies & Materials:			
Equipment & Supplies	4,681.84		
Book & Journal	240.00		
Computer Expense	730.70		
Office Supplies	18.21		
Total:	**5,670.75**	**1,500.00**	**4,170.75**
Advertising/Publishing:			
Website Development	311.47		
Printing	-		
Ads/Promotion	-		
Total:	**311.47**	**1,150.00**	**(838.53)**
Meeting Expense	331.44	**650.00**	**(318.56)**
Travel	1,026.46	**499.74**	**526.72**
Other Expense	2,438.00	**3,066.00**	**(628.00)**
Grand Total:	**18,658.97**	**18,665.74**	**(6.77)**
			(Under Budget)
		Budget	

The above represents the final accounting of the monies spent from this grant. The Grant Total represents what was initially described in the original grant proposal; the Budget Total describes the revised budget which was set after the first year of the grant. The Variance column denotes what was (underspent) or overspent within each major or minor category when compared to the Budget Total. The primary shift in grant monies occurred during the past 8 months when student help during the summer of 2011 didn't materialize. Consequently some of the student stipend monies were moved to the Supplies and Materials category. Money was saved in the advertising and publishing category primarily because I personally managed the website instead of hiring someone else to do that work.

Contact Information

Roman J. Miller, Ph.D. Project Director.
Eastern Mennonite University, 1200 Park Road, Harrisonburg, Virginia 22802
Phone: 540-432-4412; Email: millerrj@emu.edu

5.
Project Title: A New Nursery Production and Marketing System
Lead: P. Schultz & J. Owen
Amount: $21,750

I. Project Summary

The US nursery industry started in the 1700s with the production, harvest, shipping and marketing of bare root trees. Current nursery and production systems, that led to poor quality tree root systems (roots to deep in the root balls; structurally defective roots; educed root biomass), are causing significant landscape losses due to poor tree establishment and growth. In addition, fuel costs are making shipping and landscape caliper trees, both balled and burlapped and container-grown, less economically feasible for growers and purchasers.

A new system for producing, holding and marketing landscape-caliper trees is proposed for development at Virginia Tech. The system is based on producing bare root trees for harvest and subsequent sale in the urban landscape. Because tree species respond differently to bare rooting, more than one taxa of tree needs to be evaluated. The overall objective of this system is to evaluate a new production system, designed with stakeholder input, that yields bare root trees to be planted in the urban landscape.

II. Project Approach

My name is Dr. Jim Owen. I am the new nursery crops researcher at the Virginia Tech Hampton Roads Research and Extension Center located in Virginia Beach. I began my new position on August, 2011. Upon my arrival I was asked to assume responsibility of the grant entitled 'A New Nursery Production and Marketing System' that was awarded to my predecessor Dr. Bonnie Appleton at which time I requested a no cost extension with a new completion date for the grant of March 3, 2012. Please note that the overall arching theme of the grant remained the same, however methods and specific objectives were altered to ensure high quality quantitative research is provided to the sponsor.

Dr. Owen sought input from nursery stakeholders regarding the specifics of a feasible, cost-effective bare root production system in Fall 2011. Worthington Farms Inc. (Greenville, NC) and Wescoat Nurseries Inc. (Eastville, VA) provided valuable input into what would be a feasible, profitable production system and information on current and future markets. The primary market identified was bare root shade trees greater than 2" in caliper for regional sale and immediate planting in the urban landscape. The production system desired by the stakeholders was conventional in-field (soil) production. During production trees would be root-pruned one or two times annually for ease of digging and increase of transplant success once saleable size was reached. Soil would be removed with air or water at time of harvest. There remained questions about time of harvest and transplant success with 2" caliper trees, specifically oak and elm that are in high-demand in the urban landscape and known to be difficult to transplant.

III. Goals and Outcomes Achieved

Research was initiated in winter 2011-2012 at the Virginia Tech Hampton Roads Agricultural Research Experiment Station to investigate transplant success of large caliper trees. Bare root five to six foot tall whips of white oak (*Quercus alba*) and American elm (*Ulmus americana* 'Valley Ford') were purchased from J. Frank Schmidt and Son Co., Boring OR. Research plots (0.06 acre; 50 ft x 50 ft) were prepared with a 24-inch plow, disc, and roto-tiller. Forty-nine white oak and forty-nine American elm were planted on March 2, 2012. Trees were planted on 6' x 6 ft spacing. Trees were staked using fiberglass stakes and drip irrigation was installed April 2012. Trees will be grown to caliper using liquid fertilizer applied with a chemical injector when irrigating. Trees will be root pruned as needed during production. When trees reach approximately 2" caliper they will be harvested before leaf senescence (early fall), at time of leaf senescence (late fall, early winter) and after leaf senescence (winter). Soil will be removed using high-pressure air via an air-spade. Trees will be stored in pine-bark for 2 to 3 days before being replanted at the Hampton Roads Agricultural Research Experiment Station. Transplanted trees will be monitored throughout spring to determine survival and record time of leaf emergence. In addition, post transplant growth will be determined as a measure of increase in tree caliper, tree height and length of new lateral shoots. All data will be statistically analyzed.

Research is in collaboration with a progressive mid-Atlantic nursery that is conducting like bare-root harvesting evaluations on-farm with the assistance of Virginia Tech. The participating nursery and Virginia Tech will share research findings and results of the on-farm case study with field nurseries throughout the mid-Atlantic region via on-farm demonstrations, presentations and publications such as, but not limited to the Virginia Nursery and Landscape Association's newsletter. All information relating the project will be further disseminated via the World Wide Web making it accessible to nursery producers in the US and abroad. It remains uncertain the expected adoption rate without evidence of success among a broad range of taxa, however the current need for large caliper bare root trees by landscapers and municipalities will potentially expedite the adoption in more nurseries.

Additional dollars were leveraged from the J. Frank Schmidt Charitable Family Trust for a related study in which we are investigating the impact of storage longevity on the subsequent growth of bare-root shade trees.

IV. Beneficiaries

Field nurseries in Virginia and the mid-Atlantic region would benefit from a growing market for large caliper bare root shade trees. Specifically, Worthington Farms Inc. has identified this as an essential market and are conducting concurrent research on multiple tree taxa. All findings from research conducted at Virginia Tech and by participating stakeholders will be disseminated to the industry and scientific peers via meetings or publications.

V. Lessons Learned

The greatest lesson learned is there remain many barriers to adoption of this newly proposed production system. The critical components include rooting substrate, harvest timing, storage/transport of bareroot trees and transplant success. In addition, few "early-adopters" showed interest in such a radical, unproven change as proposed in the "new nursery production and marketing system" due to cost and needed modification to their existing production

practices. However, the early adopters, who Virginia Tech engaged, vested time and money in the process to ensure successful completion of some components of this applied research. The research project will continue as proposed, but will be separated into researchable components and will use a modified conventional system using soil as the substrate. Research being conducted will take the first steps to evaluate transplant timing (summer, fall, winter) for large caliper, bare-root urban trees.

VI. Additional Information – n/a

VII. Contact Information

Jim Owen, Assistant Professor, Nursery Crops
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Hampton Roads Agricultural Research and Extension Center
1444 Diamond Springs Road, Virginia Beach, VA 23455
Tel: 757.363.3904 Email: nsy.prod@vt.edu
Web: www.arec.vaes.vt.edu/hampton-roads/

6.
Project Title: Pumpkin Promotions
Lead: A. Straw
Amount: $15,000

I. Project Summary

The Blue Ridge Plateau of Southwest Virginia is becoming one of the, if not the, premier pumpkin production region in the United States. Growers in this region, as well as other parts of Virginia, are producing some of the highest yields and highest quality pumpkins of any part of the country. Producers in the Blue Ridge Plateau region probably grow 2,500 to 3,000 acres of pumpkins, annually. Statewide pumpkin acreage is estimated at between 4,000 and 5,000 acres. This acreage easily accounts for at least $15 million in annual agricultural sales.

With the acreage, yield and quality of pumpkins produced in Virginia, there is no reason that Virginia should not be the "Pumpkin Capitol of the World". This title is not just about bragging rights. It is about the rest of the country looking at Virginia as the number one source of high quality pumpkins.

Even though our producers are among the best in the country, there are promotional strategies and research that can be implemented / conducted to help pumpkin producers in Virginia fair even better. As a rule, our producers are able to sell most of the pumpkins they produce. However, when several parts of the country have good crops, moving the crop is more of a challenge. Identification and promotion of "Virginia Grown Pumpkins" could increase total sales of Virginia pumpkins. Also, if the product is identified as a "premium" product, then the price paid to the grower could also increase. This promotion could be as simple as printing "Virginia Grown" on pumpkin bins. Even more local language could be used such as "Mountain Grown Pumpkins of Virginia".

Again, the pumpkin producers of Virginia are among the best in the nation, they still need current recommendations on varieties, crop protectants, cultural practices, fertility, etc. With some monetary support for research, researchers should be able to provide producers with the latest production information. Variety trials are conducted in Virginia each year. However, with some financial support these trials could be expanded to other areas of Virginia. Also, fertility and crop protectant research efforts could be expanded with increased funds. This research is needed to keep Virginia growers on the cutting edge.

There has been concern for the last couple of falls that the depressed economic conditions could possibly hurt pumpkin sales. Some marketing venues have reported decreased sales. However, discussions with producers throughout Virginia have shown that most growers sold out of pumpkins earlier than normal and that overall sales have been good. Again, this is likely a result of buyers recognizing the quality of Virginia grown pumpkins.

The Virginia Pumpkin Growers Association with the help of VDACS, VCE and others wants to promote this valuable commodity, and help Virginia producers improve farm income, profitability and sustainability. And maybe in the near future, Virginia may become rightfully recognized as "The Pumpkin Capitol of the World".

The Virginia Pumpkin Growers Association originated out of a need to replace the "dying" cabbage industry of Southwest Virginia. Representatives from VDACS, VCE and the Southwest Virginia Farmer's Market sorted through various crops and scenarios and settled upon pumpkins as having the most potential. Therefore, the Virginia Pumpkin Growers Association was born to promote Virginia grown pumpkins, as well as educate producers in pumpkin production. This promotion and development has included an educational meeting held in January of each year, an annual educational field day held each summer and a website promoting pumpkin production in Virginia.

Since the inception of the Virginia Pumpkin Growers Association, pumpkin acreage in Virginia has more than doubled and is close to tripling. The economic impacts have been estimated as high as $10,000,000 in gross sales in Southwest Virginia alone. This has occurred at a time when sales from other commodities like cabbage have been steadily decreasing.
It is sometimes difficult to put absolute values on estimates of economic impacts. However, if promotional efforts increase gross sales by 5 to 10%, that could amount to approximately $1,000,000 in growers pockets. If promotion of the quality of the pumpkins resulted in a 5 to 10% price increase, then another $1,000,000 in increased gross sales. Increased efficiency in production and increased yields could net pumpkin growers as much as another $1,000,000 in net revenue. If all of these impacts were successful this could amount to between $2,000,000 and $3,000,000 in increased net revenue to the pumpkin growers of Virginia. Again, these are estimated impacts, but not unreasonable estimates.

II. Project Approach

Production

A strip-till machine was leased for two years and tillage trials were conducted during both the 2009 and 2010 production seasons. During 2009, a trial was established at the State Mental Hospital in Marion. They wanted to produce pumpkins on a piece of "sod" land that had been out of production for several years. The strip-till unit was run over the area and then fertilizer was banded in the tilled area and the strip-till unit was run through the field a second time. Pumpkins were planted into the strip-tilled areas. The pumpkins performed very well. Exact yields were not obtained, but the plants were very healthy and productive. Actually, the production was excellent.

Also in 2009, a producer that had been growing pumpkins no-till wanted to try to improve his production. He had grown several acres years ago, but had decreased production due to disease (Phytophthora) and production problems. We helped the grower experiment with the strip-till unit. His production was 50% greater than it had been in years. Actually, it was the first decent pumpkin crop the grower had produced in 5 to 7 years.

In 2010, a trial utilizing the strip-till unit was conducted at the farm of the Holston High School FFA chapter. Approximately one half of the pumpkins were planted utilizing the strip-till unit as compared to conventional tillage methods. Two varieties, a large early season variety, 'Spartan'; along with a small pie variety, 'Hybrid Pam', were also utilized in the trial. The results were

somewhat mixed. Plant Stands were not significantly different between tillage treatments. However, slightly better plant stand were obtained with strip tillage for both cultivars. For 'Hybrid Pam', the small variety, the strip-till treatment increased yields by over 60% as compared to the conventional tilled area. With the large fruited 'Spartan', the conventional tilled area out produced the strip-tilled area by nearly 38%. When evaluating fruit size no difference was observed in the size of the 'Hybrid Pam' fruit between tillage systems. However, the 'Spartan' pumpkins grown utilizing strip-till averaged almost 3 pounds heavier as compared to conventionally grown 'Spartan' plants.

Also in 2010, the strip-till unit was taken to two producers that normally produce no-till pumpkins for their evaluation. They each planted part of their production fields utilizing the strip-till unit. In both cases early season plant growth was better in the strip-tilled area as compared to the no-till. At the end of the season little difference was observed in the growth of the plants. In both cases, the plots were harvested before yield data could be collected.

Multiple variety trials (six) were conducted across the Commonwealth in 2009 and 2010. Other trials were also conducted in adjoining states. Several varieties like 'Aladdin' and 'Warlock' have been identified as consistent producers. Other new varieties with potential have been identified. 'Gladiator', 'Magic Wand' 'Hijinks, 'Packer', 'Captain Jack', 'Diablo', 'Challenger', 'Spartan' are some of the varieties identified that have potential.

Also, in 2009, a fungicide trial was conducted in Montgomery County. Two varieties, one with powdery mildew tolerance and one without, were treated with various fungicides to control downy and powdery mildew. Downy mildew never developed. However, powdery mildew did develop. The use of a powdery mildew variety reduced disease pressure by approximately 50%. Several powdery mildew fungicides showed great activity against the disease. However, Folicur, a relatively new product was identified as having good activity, at less than ½ the cost of the standard products (less than $10 per acre as compared to approximately $20 per acre for the other standard treatments).

Marketing and Promotion

During 2009 and 2010, the website of the Virginia Pumpkin Growers Association was updated and made more "search engine" friendly. This updating has resulted in more "hits" and more inquiries. We do not have a definite number on how much the activity has increased, but it has increased significantly. As a matter of fact, the website led to the Southwest Virginia Farmers Market delivering pumpkins to the White House in Washington, D.C. in the fall of 2010.

Other promotional efforts by the Virginia Pumpkin Growers Association led to a media day and the delivery of pumpkins to the Governors' Mansion in Richmond. Three growers and their families delivered pumpkins from various parts of the Commonwealth.
Over the last 2 to 3 years, efforts have been made to "sell" the quality of pumpkins grown in Virginia. Buyers appear to be responding. I and other industry leaders have encouraged clients in neighboring states to buy pumpkins grown in VA. Several loads are now going to adjoining states like Tennessee and North Carolina each year. Records from the Southwest Virginia Farmers Market show nearly a 5% increase in number of pumpkin sold between 2008 and 2009;

and a 30% increase between 2009 and 2010. This amounts to more than 50% increase in the value of pumpkins sold at the Southwest Virginia Farmers Market between 2008 and 2010.

III. Goals and Outcomes Achieved

2009 and 2010 were very difficult years for producers. Many areas of the Commonwealth experienced drought conditions at times during both seasons. 2010 was much hotter than normal. It is difficult to estimate yield differences among years, but the feeling is that yields were slightly lower than normal in 2009. However, the price paid for pumpkins was up in 2009; therefore, the dollar value of the crop was similar to that produced in 2008. Despite the heat and drought conditions in 2010, yields seemed about normal. With the higher prices received the value of the pumpkin crop appeared to greater than in 2008 and 2009.

Variety trials conducted have identified varieties that produce consistent yields in varying environmental conditions. Most Pumpkin producers are now growing these varieties. Therefore, during these stressful production seasons, yields are staying more consistent.

The tillage trials conducted over the past two years have shown growers more efficient ways of producing pumpkins while minimizing soil erosion. Several growers have expressed interest in trying strip-tillage in 2011.

The fungicide trial conducted revealed a new fungicide that was very effective and much cheaper than the products the growers were presently using. This change alone could lower the growers production costs.

I believe the promotion of Virginia Grown pumpkins has gotten the attention of many buyers in the Southeastern U.S. Continued promotion and research should help make Virginia "The Pumpkin Capitol of the World".

IV. Beneficiaries

The direct beneficiaries of this project were the pumpkin growers of Virginia. The results of trials were shared with growers at the annual meetings of the Virginia Pumpkin Growers Association and the Appalachian Regional Horticulture Conference during 2010 and 2011. Growers also received information about results at other local and regional meetings conducted across the Commonwealth.

The use of strip-tillage has the potential of increasing pumpkin yields as compared to no-till practices, while minimizing soil erosion. We do not have concrete numbers as to the exact economic impact yet, but should have a better idea at the end of the 2011 season.
The use of Folicur, a powdery mildew fungicide could reduce production costs by 1 to 2%. The implementation of other more efficient production practices could easily save pumpkin growers up to 5% in their production costs.

The promotion of Virginia Grown pumpkins has resulted in increased sales at a State operated Farmer's Market. This includes an increase of over 35% in numbers of pumpkins being sold and more than 50% increase in dollar value of the sales.

V. Lessons Learned

Growers are often quick to volunteer to help with trials and projects. That is good, but they often don't under understand all that is required to do on farm research. Therefore, it is often hard to obtain could quantitative data when the grower harvest the plot area before you can collect data. Working with other State agencies can be rewarding, but also a challenge if they are not used to doing research.

It is very difficult to collect statewide data that is reliable. Therefore it is hard to tell if the trends at the Southwest Virginia Farmers Market are consistent across the Commonwealth. However, one would have to assume that we reached the goal of 5 to 10% increase numbers and in value given the 35% increase in volume and 50% increase value.

VI. Additional Information

Website of the Virginia Pumpkin Growers Association (pumpkinva.org)
Contact information:
Allen Straw
VA Pumpkin Growers Association
276-944-2202
astraw@vt.edu

7.
Project Title: Enhancing Productivity of Small Beekeepers in Southside Virginia
Lead: M. Jones
Amount: $7,900

I. PROJECT SUMMARY

Our goal was to help small quantity BeeKeepers overcome the financial and educational barriers that often exist. We intended to promote the cause of Bees as primary pollinators in the Food chain for our human population. At the same time we targeted the education of the public on the serious declines that are occurring throughout the apiary infrastructure of Virginia and elsewhere.

II. PROJECT APPROACH

Our primary approach was to form a consortium of persons/organizations that were interested and/or involved in the art of BeeKeeping. Out of this desire, the Southside BeeKeepers Association was formed. The membership opportunities were advertised throughout Southside Virginia and members solicited. The methodology to educate these interested persons [22 members at present] involved combining the knowledge of experienced BeeKeepers from the private sector with the professional wisdom provided by speakers/programs throughout the period. It was a well-rounded and well-accepted and highly successful method.

VDACS Apiary Specialist were asked to speak at 10 functions. Virginia Cooperative Extension Specialist honed the meetings and provided invaluable resources throughout. Meeting space and meeting notices for the monthly meetings is provided by VCE. The steadily growing membership has been very enthusiastic. Officers have been elected and the meetings will continue long after this grant is expended and closed.

III. GOALS and OUTCOMES ACHIEVED

A consortium of demonstration and practical BeeKeeping Supplies were purchased. A mobile trailer for on-farm demonstrations and use by Association members was also purchased and has attracted much interest (26 site visits at present). The effectiveness of this project is long-term and ongoing. Interest is steadily rising in the Association which now includes members from six Southside Virginia jurisdictions. Members and Leaders have provided approximately 54 outreach programs to organizations. These recipients include women's clubs, garden clubs, Ruritans, DAR meetings, Boy and Girl Scouts, County Fairs and Festivals, 4-H, Farm Days, etc. Two demonstration hives were purchased and installed at the VCE office and is partially maintained by the local 4-H clubs. The public is invited to observe and learn.

Also, as a defined group, it was possible to order private BeeKeeping supplies in bulk which resulted in large dollar savings over time.

Three day-long events were sponsored and well attended (320). BeeKeepers provided the manpower and knowledge necessary to carry out these events.

Honey production has increased by 10% (20% goaled). Contributing factors for the 10% actual vs. the 20% goaled:
1] Many new hives just being established;
2] Extremely dry weather which greatly restricted flowering of native plants; 3] Extremely cold weather during past two winters (some hives lost)

The number of active hives in the targeted area has increased from fifteen (15) to approximately fifty-three (53). A 350% increase [50% goaled] in hives and this number will expand significantly again in 2011.

IV. BENEFICIARIES

The entire Southside Virginia community (multiple counties/cities) has benefited greatly from this project. The natural environment has truly benefited also in immeasurable ways. Through newspaper and other media outlets, the general public has become more aware of the plight that our primary pollinators are facing. This local effort, combined with the national recognition of this issue, has broadened the knowledge base of thousands of people. The least of which is our membership and their efforts to provide a valuable pollinating source along with a potential income steam from their farm and their backyard.

V. LESSONS LEARNED

Surprise, the public has a sincere desire to improve their environment. By providing this avenue to accomplish that goal, we feel as a group, that not only us, but all around us have benefited immensely from this endeavor. Without this Grant type funding, the entire goal would not have been achievable or successful.

VI. Additional Information

Not Applicable

Questions regarding this Final Report should be addressed to:

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Jarratt, VA 23867
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